Vol. 12, No. 11
June 15, 1987

Energy Research Abstracts

Abstracts 22083-24384

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $63.00 for domestic (North America) or $78.75 for foreign (outside North America) subscribers; a single issue is $6.00 or $7.50, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion ($A > 4$) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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energinfo ERA
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Vol. 12, No. 11
ISSN: 0160-3604
CODEN: ERABD
June 15, 1987

ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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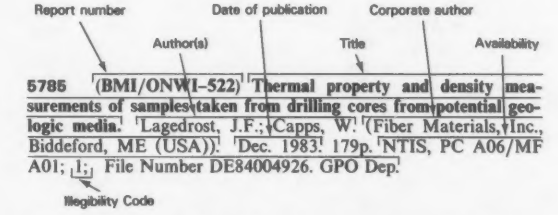
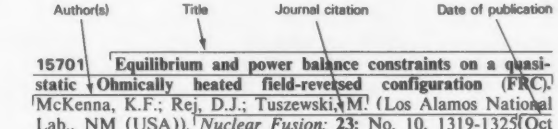
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
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• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
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Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
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IEA Coal Research
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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

NOVA Information Services Company
Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 41 first-level and 276 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

22083 (DOE/EIA—0064(85)) Coal data: A reference. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 6 Mar 1987. 102p. NTIS, PC A06 - GPO. File Number DE87007314.

This is the fifth edition of Coal Data: A Reference, a summary of information about coal, an important energy source in the United States. Intended for a wide audience, the purpose of this reference is to answer general inquiries and to broaden the reader's knowledge of coal deposits, mining, production, consumption, and exports. This updated and expanded edition includes a variety of carefully selected additional information gleaned from a variety of sources. It contains an overview of United States coal, a brief historical sketch, a section on terminology and related information, statistics, figures, maps, photographs, and an index. Selected references and sources of information are listed for the reader who is interested in going beyond the scope of the report. Most of the statistical information in Coal Data: A Reference is from reports published by the Energy Information Administration (EIA). Current statistical data and information about the various coal-related reports published by EIA are available from the National Energy Information Center, EI-20, Forrestal Building, Energy Information Administration, Washington, DC 20585; telephone (202/586-8800). 36 figures, 38 tables.

0103 Preparation

REFER ALSO TO CITATION(S) 22118, 22120, 22146

22084 (BNL—39372) The treatment of some low-rank coals with carbon dioxide water: Effects on slurry-relevant properties: Final report. Slegeir, W.; Sanchez, J.; Coughlan, R.; Sapienza, R.; Butcher, T.; Healy, F. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006739.

This project is concerned with the results of employing CO_2/H_2O treatments on two low-rank coals. The coals employed in this project were North Dakota lignite from the Indianhead Mine and Utah subbituminous from the Sufco mine. This project is concerned with changes in slurry-relevant characteristics for these low-rank coals due to such treatments. These characteristics include equilibrium moisture, ash content and composition, grindability and slurry rheology. Batch CO_2/water treatments on North Dakota Indianhead lignite afforded a reduction in coal-bound moisture, affording as much as a 35% decrease in equilibrium moisture content. The resulting treated lignite also proved to be a "cleaner" coal, with a 30 to 35% reduction in ash content. For the Utah Sufco coal, no appreciable changes in equilibrium moisture were attained and the ash contents generally only slightly reduced Sufco. However, for the more severe treatment, alkaline and alkaline earth were lowered appreciably, with a commensurate increase in ash fusion temperature. For both coals, some improvements in grindability were realized under the most severe treatment conditions (80°C, 1200 psi). The less severe conditions afforded little changes in grindability. Some measurements taken of the rheology of treated -200 mesh Indianhead coal slurries have shown non-Newtonian behavior. These slurries settled rapidly when concentrations greater than 50% were reached, hence viscosity measurements were difficult to obtain. Although the mechanism of CO_2/H_2O action on coal is not clear, the results of this project are consistent with an ion-exchange process, whereby the basic components are exchanged with the hydronium ion of the CO_2/H_2O mixture. Such ion exchange may lead to other changes in the coal matrix. 38 refs., 8 figs, 18 tabs.

22085 (DOE/FC/10622—2290) Ultrafine grinding of low-rank coal: Final report. Bouchillon, C.W.; Steele, W.G. (Mississippi State Univ., Mississippi State (USA)). Aug 1986. Contract AC21-84FC10622. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001077.

A study of ultrafine grinding of low-rank coals in a fluid-energy mill was undertaken. This report presents the results of the Phase I effort which included a review of the literature on ultrafine grinding, a review of theories of grinding, a combined grinding and drying experiment on Martin Lake Texas lignite, an evaluation of the energy requirements for the process, and an evaluation of the properties of the products from the grinding tests. A sample of Martin Lake Texas lignite was obtained and a series of tests were conducted in a fluid-energy mill at the Ergon, Inc., Micro-Energy Division development facility at Vicksburg, MS. The grinding fluids used were air at 116 F and steam at 225, 310, 350, 400, and 488 F as measured in the mill. The products of these tests were analyzed for volatile mattr, ash, total moisture, equilibrium moisture, heating value, density distribution, aerodynamic particle size classification, angle of repose, porosity, density, and particle size distribution. ASTM test procedures were followed where applicable. Ultimate and ash mineral analyses were also conducted on the samples. Results of the various tests are presented in detail in the report. In general, the fluid energy mill was used succssfully in simultaneous grinding and drying of the lignite. Particle size reduction to less than 10 microns on a population basis was achieved. The equilibrium moisture of the samples decreased with increasing grinding fluid temperatures. Density distribution studies showed that a significant fraction of the ash appeared in the >1.6 specific gravity particles. The energy required for the grinding/drying process increased with increasing mill temperatures. 29 refs., 18 figs., 13 tabs.

22086 (DOE/PC/80525—T6) Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 6, December 1, 1986-February 28, 1987. Hwang, C.C.; Chiu, C.L. (Pittsburgh Univ., PA (USA). School of Engineering). 30 Mar 1987. Contract FG22-85PC80525. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007683.

During the sixth report period, major tasks included: (1) analysis of experimental data available in literature by using a digitizer and re-plotting by computer graphics, (2) design and fabrication of a model hydrocyclone with the vertex angle of 11 degrees. 3 refs., 7 figs.

22087 Apparatus for magnetic separation of paramagnetic and diamagnetic material. Doctor, R.D. (to Dept. of Energy). US Patent Application 6-889,131. 24 Jul 1986. 18p. Contract W-31109-ENG-38. DE87007201 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007201.

The present invention relates to methods and apparatus for segregating paramagnetic from diamagnetic particles in particulate material and, in particular, to the open gradient magnetic separation of ash producing components and pyritic sulfur from coal. The apparatus includes a vertical cylinder and a rotatable vertical screw positioned within the cylinder, the screw having a helical blade angled downwardly and outwardly from the axis. Rotation of the vertical screw causes denser particles, which in the case of coal include pyritic sulfur and ash, which are paramagnetic, to migrate to the outside of the screw, and less dense particles, such as the low sulfur organic portion of the coal, which are diamagnetic, to migrate towards the center of the screw. A vibration mechanism attached to the screw causes the screw to vibrate during rotation, agitating and thereby accommodating further segregation of the particles. An open gradient magnetic field is applied circumferen-

tially along the entire length of the screw by a superconducting quadrupole magnet. The open gradient magnetic field further segregates the paramagnetic-particles from the diamagnetic particles. The paramagnetic particles may then be directed from the cylinder into a first storage bin, and the diamagnetic particles, which are suitable for relatively clean combustion, may be directed into a second storage bin. 5 figs.

0104 Processing

REFER ALSO TO CITATION(S) 22140, 22141, 22144, 22154, 22176, 23613

22088 (CONF-8511136—) **Direct liquefaction contractors' review meeting: Proceedings.** (USDOE Pittsburgh Energy Technology Center, PA). 1985. 915p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The Fifth Annual Direct Coal Liquefaction Contractor's Review Meeting was held on November 19-21, 1985 at the Hyatt Hotel, Pittsburgh, PA. This year's meeting combined the Contractors working in Direct Liquefaction for both the Liquefaction Project Management Division and the Advanced Research Contracts Division of PETC. The purpose of this meeting was to review the status of research and development work being sponsored by DOE in all areas of Direct Coal Liquefaction. A second purpose was to promote a technical exchange among DOE and DOE contractors in these areas and add insight into how individual projects fit together to support the overall program. This volume of proceedings consists of the meeting agenda and speakers, list of attendees, abstracts or report presented, and copies of material distributed by speakers. Selected papers and abstracts have been processed for inclusion in the Energy Data Base.

22089 (CONF-8511136—, pp I.1-I.41) **Recent developments in two-stage coal liquefaction at Wilsonville.** Gough, J.R.; Lamb, C.W.; Nalitham, R.V.; Lee, J.M.; Johnson, T.W. (Catalytic, Inc., Wilsonville, AL; Southern Co. Services, Inc., Birmingham, AL). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Results are presented for three runs that were completed during the past year in the Advanced Coal Liquefaction R and D Facility at Wilsonville, Alabama. Several configurations of integrated two-stage liquefaction were investigated using both bituminous and subbituminous coal feeds. Interesting results were obtained with a two-stage configuration that employed hydrotreating of nondeashed feed. The effect of the addition of iron oxide to the coal slurry as a disposable catalyst was tested with both coal feeds. The process results from the runs are characterized by the presentation of representative product yields and product quality data. A variety of related topics are discussed. Several aspects of dissolver mixing are presented. A radioactive tracer test was performed to determine the degree of mixing in the dissolver. In the subbituminous run, a pumparound loop was added to ensure that the dissolver was well mixed. 6 refs.

22090 (CONF-8511136—, pp I.42-I.60) **The catalytic two-stage liquefaction process.** McLean, J.B.; Comolli, A.G.; Duddy, J.E.; Smith, T.O. (Hydrocarbon Research, Inc., Lawrenceville, NJ). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Under a recently completed contract with the US Department of Energy, Hydrocarbon Research, Inc. (HRI) has been studying a new process based on the low-severity two-stage, catalytic, ebullated-bed hydroliquefaction of coal. The objectives of this program have been to study, develop, and demonstrate a new two-stage process on Illinois No. 6, Burning Star Mine, bituminous and Wyodak, Clovis Point, sub-bituminous coals with the target of increasing yields of high-quality distillate while improving hydrogen efficiency and reducing catalyst deactivation rates. The process is based on the use of two direct-coupled, ebullated-bed catalytic reactors in series; with the first stage operating at low (<800°F) temperature for hydrogenation and the second stage at higher (>800°F) temperature for hydro-conversion. Fifteen months were devoted to the Illinois No. 6 coal studies and twelve months to Wyodak coal. Each study consisted of multiple experiments examining process variables on a microautoclave and continuous bench unit scale followed by bench unit demonstration runs on each coal examining catalyst deactivation. An engineering economics study on Illinois No. 6 coal was also completed in this program. It included conceptual single- and two-stage plant designs, followed by cost comparisons and linear programming economic studies. The results from the sub-bituminous coal studies are summarized and compared with earlier results from the bituminous coal. A summary comparison of the differential economics of two-stage versus single-stage processing for Illinois No. 6 coal is also presented. 2 refs., 5 figs., 9 tabs.

22091 (CONF-8511136—, pp I.61-I.75) **Amoco's integrated close-coupled coal liquefaction bench scale test.** Tait, A.M.; Schwartz, M.M.; Pacheco, M.A. (Amoco Oil Co., Naperville, IL). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-81PC40009.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Amoco's close-coupled thermal-catalytic coal liquefaction process was tested in Hydrocarbon Research Incorporated's (HRI) Bench Unit 227 using Illinois No. 6 coal and AMOCAT-1C catalyst in the second stage. This test, identified as HRI Run 227-24, was conducted over a 23-day period using several sets of operating conditions at different first- and second-stage temperatures and space velocities. At the final set of conditions, maintained for eleven days, production of distillate (C_4-975°F), in a solvent balanced operation was sustained near 60 wt %, MAF coal basis. In addition, high resid conversion was maintained, with little change in preasphaltene yields. Catalyst deactivation was negligible, as judged by sustained desulfurization and denitrogenation activity. 7 refs., 9 figs., 7 tabs.

22092 (CONF-8511136—, pp I.76-I.110) **The development of Lummus Crest Inc. integrated two-stage coal liquefaction process: Enhanced ITSL [Integrated Two Stage Liquefaction] configuration.** Gupta, A.; Peluso, M.; Schiffer, A.; Greene, M. (Lummus Crest Inc., Bloomfield, NJ). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-79ET14804;AC22-82PC50021.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The process development program for the enhanced ITSL Process was carried out to demonstrate the technical and economic merits of this concept. A modified ITSL flowscheme, which consists of an LC-FINING unit of reduced reactor volume coupled with a downstream fixed-bed hydrocracking unit, was operated to obtain the technical data needed to estimate the effect of this modification on yields, hydrogen efficiency, product quality and reactor volume requirements. This process improvement, which we have called the ITSL Enhancement, has the potential to reduce the capital investment of the ITSL process, while making a higher quality product. The process flow modification was tested in an experimental PDU program and the results revealed the following: Total second-stage reactor volume was reduced by 18%, with 65% of the volume contained in the fixed-bed hydrocracking reactor. Expanded bed reactor volume was reduced 72%. A -650 F ITSL product was made containing less than 100 ppM sulfur and less than 1000 ppM nitrogen, with no apparent loss of hydrogen efficiency or increase in gas yield. The -650 F product has toxicity characteristics similar to petroleum fractions. The distillate fraction of the recycle solvent contained a greater concentration of cyclic hydrogen than had been attained previously, thus making it a potentially better hydrogen donor solvent. The distillate fraction of the recycle solvent had physical properties that may enable it to be a good antisolvent, thus greatly simplifying the deashing section of the ITSL process. This experimental program was performed only on the second-stage LC-Finer. Therefore, it is recommended that an integrated ITSL program be carried out in order to optimize the enhanced ITSL process and take full advantage of its potential. Such optimization is expected to result in further reduction in second stage reactor volume. 8 refs., 15 figs., 8 tabs.

22093 (CONF-8511136—, pp I.111-I.125) **Formation of carbonaceous deposits on coal liquefaction catalysts.** Stohl, F.V.; Stephens, H.P. (Sandia National Labs., Albuquerque, NM). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC04-76DP00789.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

We have previously reported that direct coal liquefaction catalyst samples, from three different runs at the Wilsonville Advanced Coal Liquefaction R and D Facility, lost greater than 75% of their catalyst hydrogenation activity and 50% of their hydrodesulfurization activity within the first few days of coal processing. These rapid activity losses were due to homogeneous pellet deactivation by carbonaceous deposits. The objective of the work presented in this paper, which is part of a larger study aimed at extending catalyst life by mitigating the effects of carbonaceous deposits, was to determine the rate of catalyst deactivation by various Wilsonville hydrotreater feeds and their distillate cuts. Each deactivation experiment was performed by catalytically hydrogenating a feed component in a batch laboratory microreactor for 2 hours using gas-phase presulfided Shell 324M catalyst. The reactants and products of these experiments as well as the used catalysts were analyzed for carbon, hydrogen, nitrogen and sulfur. Catalyst testing for hydrogenation and hydrodesulfurization activities was performed using model compounds. Results of this work show that the highest boiling fractions cause the greatest activity losses. For example, extrudate hydrogenation activity losses ranged from 23% for experiments with the lowest boiling fraction to 82% for a high boiling point feed component. Although hydrodesulfurization activity was not affected by the low boiling fraction, a 70% loss resulted from hydrotreating the highest boiling point component. Current studies, aimed at identifying and separating different classes of compounds in the feeds to enable the determination of their individual effects on catalyst activity, are also discussed. 5 refs., 3 figs., 3 tabs.

22094 (CONF-8511136—, pp I.126) **Low severity coal liquefaction using liquid clathrates.** Atwood, J.L. (Univ. of Alabama, University). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Significant recent developments have occurred on three fronts. First, air-stable liquid clathrates based on the reaction of $AlCl_3$ with diphenylphosphite have been prepared. The ability of the new substances to attach the coal matrix appears to be at least as good as that of the air-sensitive ones. Second, clathrate-compatible hydrogenation catalysts have been used to bring about an upgrading of the material in the liquid clathrate phase. The amount of extractable material has been increased from a maximum of 7% to 15% in the case of the high-volatile bituminous coal Devco. The use of catalysts has also necessitated the development of new work-up procedures for the analysis of the coal-derived material in the liquid clathrate phase. Preliminary numbers show that the total amount of coal dissolved does not increase with the use of the hydrogenation catalyst. (Note that due to the integral nature of the aromatic in the formation of a liquid clathrate, only olefin hydrogenation catalysts have been used.) The third development concerns an important expansion of the work from 'ambient' to 'low severity' conditions. At room temperature and pressure as much as 30% of the coal could be dissolved, but at 200°C and 500 psi H_2 preliminary results are running at well over 50%. We will concentrate heavily on the new results, and on the role of the liquid clathrate in conditions of low severity. We had shown that the dissolution is a physical process at ambient, but more work will be required to establish this in the new studies.

22095 (CONF-8511136—, pp II.1-II.29) **Effects of feed boiling range on hydrotreating of Wyodak and Illinois ITSL [Integrated Two-Stage Liquefaction] oils.** Sullivan, R.F. (Chevron Research Co., Richmond, CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-76ET10532.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Syncrudes produced from Illinois No. 6 and Wyodak coals in the Integrated Two-Stage Liquefaction (ITSL) process were upgraded in pilot plant tests by hydrotreating with Chevron's commercial ICR 106 catalyst. Syncrudes with end points ranging from 725°F to 900°F were studied. In this range, relatively small increases in end point made the oils much harder to upgrade. Therefore, the hydrotreating severity had to be increased for the higher end point oils to make product of a given quality. In all cases, however, we found commercially feasible conditions to remove virtually all of the heteroatom impurities. At a given feed EP, processing severities required for Illinois and Wyodak oils were about the same. In this paper, we compare properties of the Illinois and Wyodak ITSL oils and their products. The high density jet fuel and diesel products are of particular interest because of their high volumetric energy content. 5 refs., 8 figs., 8 tabs.

22096 (CONF-8511136—, pp II.30-II.54) **Composition of recycle oil from HRI's [Hydrocarbon Research, Inc.] catalytic two-stage liquefaction process.** Winschel, R.A.; Robbins, G.A.; Burke, F.P. (Conoco Coal Research Div., Library, PA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-84PC70018;AC05-79ET14503.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The Catalytic Two-Stage Liquefaction (CTSL) process being developed by Hydrocarbon Research, Inc. uses two ebullated-bed catalytic reactors in series to convert coal to distillate oils. The performance of the process with bituminous coal was demonstrated in Run 227-20 which was operated at constant conditions for 25 days with a single charge of catalyst. Over the course of the run, the second-stage heavy products (recycle oils) decreased in quality. The resid content of the oil increased. The resid product became more aromatic and more phenolic and increased in preasphaltene content. The distillate product became more aromatic and phenolic. The ability of the second-stage product to convert coal under donor conditions decreased. The likely cause of the decrease in second-stage product quality is catalyst deactivation. Hydrogenation, hydrocracking and deoxygenation functions all appear to be directly or indirectly affected. Despite this evidence of catalyst deactivation, Run 227-20 demonstrated a significantly improved yield structure as compared to results of H-Coal processing of bituminous coal. The heavy products (recycle oils) are significantly less aromatic (more hydrogenated) and contain fewer preasphaltenes than H-Coal oils. Catalyst deactivation rates, based on rates of change of measured product oil properties as a function of high temperature catalyst age, are significantly less for CTSL Run 227-20 than for comparable H-Coal operations. 6 refs., 10 figs.

22097 (CONF-8511136—, pp II.74-II.101) **Recent advances in two-stage liquefaction: Preliminary economic assessments.** Gray, D.; Tomlinson, G. (The MITRE Corp., McLean, VA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

At the request of the US Department of Energy, the MITRE Corporation is evaluating the process performances of the various two-stage direct coal liquefaction configurations supported under the DOE liquefaction program. The objective of this work is to identify the technical impacts of the different process configurations and operating conditions on the overall performance and to quantify these impacts by conducting comparative economic analyses. This evaluation will thus identify the most promising approaches for the production of good quality liquid products in the most economical manner. This paper examines the techno/economic performances of the Wilsonville two-stage system in both ITSL and RITSL configurations and the Hydrocarbon Research CTSL process for an Illinois No. 6 coal feedstock. The performances of these three configurations are compared to that of the Lummus ITSL process as the base case. 6 refs., 19 figs.

22098 (CONF-8511136—, pp II.102-II.132) **Improving the quality of deteriorated recycle solvents: an ASPEN PLUS simulation of the integrated two-stage liquefaction process.** Martin, R.J.; Placek, T.D.; Tarrer, A.R. (Auburn Univ., AL). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The objective of this research was to study the maintenance of solvent quality for the ITSL mode of operation at the Wilsonville Coal Liquefaction facility. The method involved developing an ASPEN PLUS simulation of the ITSL process from pilot plant data and studying the effects of individual unit operating conditions on the overall process and determining if changes in operating conditions could be used to maintain a constant solvent quality. The simulation was limited to the case of Illinois No. 6 coal as a feed stock. Coal liquid fractions were characterized using average boiling point data and specific gravity. The physical properties of coal liquids were based on correlations developed by Tsang, Starling, and Riazi and were estimated with the aid of the Assay Data Analysis (ADA) System available in ASPEN PLUS. The ASPEN modified version of the Redlich-Kwong-Soave equation of state was used for vapor-liquid equilibrium calculations for light gases and coal liquids. In setting up a model of the overall process, unit operation models were developed for the thermal and catalytic reactors and the critical solvent deashing unit. These models were based on correlating product yields and component flowrates as functions of operating conditions. As evidenced by the data analyses and simulation results, the ITSL process can be operated such that the solvent quality can be maintained at a steady value. In particular, the catalytic reactor temperature can be varied to compensate for catalyst aging (thus, solvent deterioration) and reaction time. 2 figs., 9 tabs.

22099 (CONF-8511136—, pp II.133) **Kinetics of hydrogenation using aged catalysts.** Schweighardt, F.K. 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FG22-83PC60783.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The kinetics of pyrene hydrogenation using whole catalyst pellets of pilot plant aged Shell 324M NiMo has been quantified. The reactions were made in a modified computer controlled 1-liter Robinson Reactor with autosampling capability. A data base of whole catalyst pellet (5-25 grams) hydrogenation has been prepared, and in association with Sandia Laboratories, compared to the rate of hydrogenation using crushed (<100 mesh) and whole catalyst pellets (<0.2 grams) in a tubing bomb reactor. Catalyst samples were withdrawn from the Advanced Coal Liquefaction Facility in Wilsonville, Alabama under product oil and shipped. Pellets were washed in tetrahydrofuran, dried under nitrogen, and maintained wet under hexadecane until ready for use. Characterization of the catalyst pellets was made by Sandia Laboratories from split samples taken directly from the Wilsonville pilot plant. Reaction conditions in both laboratories were maintained at 300°C and 500 psig hydrogen. Analysis of reaction products was made by capillary gas chromatography with a phenanthrene internal standard for retention time and response factor calibration. Comparison of the rates of reaction using fresh presulfided and pilot plant aged (0 to >500 #SRC/#Catalyst) whole pellets of Shell 324M NiMo catalyst are discussed. Recommendations for a standard method to quantify the aging of coal liquefaction catalysts will be given along with the advantages and disadvantages of the method.

22100 (CONF-8511136—, pp II.134) **Role of temperature, solvent, and agitation in coal dissolution and liquefaction.** Briggs, D.E.; Ha, B. (Univ. of Michigan, Ann Arbor). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

A systematic study of the role of temperature, solvent character, and agitation in the dissolution and liquefaction of a Kentucky No. 9 bituminous coal, an Illinois No. 6 bituminous coal, and the Kerr McGee subbituminous coal was conducted in a 1-liter batch reactor at or below 400 C under a nitrogen atmosphere. Most of the recent work was done on the Illinois No. 6 coal with a light solvent containing 46 wt % tetralin, 46 wt % 2-methylnaphthalene, 5 wt % 2-naphthol, and 3 wt % 4-picoline and a heavy solvent containing 50 wt % of the light solvent, 25 wt % 9,10 dihydroanthracene, 20 wt % phenanthrene, and 5 wt % quinoline at a solvent to coal ratio of 2.5:1. Both mixtures contained approximately equal molar ratios of hydroaromatics and aromatics. In the light solvent, 85% of the DMMF Illinois No. 6 coal is converted to pyridine-solubles when held at 400 C for 25 minutes. The same conversion is attained in the heavy solvent when held at 355 C for 25 minutes or when the reaction is quenched immediately after reaching a temperature of approximately 380 C. Maximum conversion to pyridine-solubles is 92% of the DMMF Illinois No. 6 coal. It can be obtained by holding the coal at 385 C for 25 minutes in the heavy solvent before quenching the reaction. Conversion of preasphaltenes to asphaltenes is very slow in both solvents below 375 C, but increases significantly in the heavy solvent above 375 C. When held for 25 minutes in tetralin at 400 C, 63% of the DMMF Kerr McGee coal is converted to pyridine-solubles. At the same conditions in the light and heavy solvents, the conversions are 51 and 74%, respectively.

22101 (CONF-8511136—, pp III.1-III.18) **Catalysts via hydrous metal oxide ion exchangers.** Stephens, H.P.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC04-76DP00789.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Hydrous metal oxide ion exchangers made by sol-gel techniques have been used to prepare hydrogenation catalysts. These materials, which consist of hydrous oxides of Ti, Nb, Ta or Zr containing exchangeable monovalent cations, exhibit a number of properties advantageous to heterogeneous catalysis: high surface area; potential for uniformly dispersing any metal or mixture of metals over a wide concentration range by ion exchange reactions; and control of substrate acidity. In addition to synthesis in the bulk form, thin films of the hydrous metal oxides are easily coated on various substrates chosen to provide a catalyst of specific geometry or porosity. Activity of the hydrous titanate catalysts has been tested for coal liquefaction and hydrogenation of coal-derived liquids and model systems such as pyrene. Results of batch hydrogenation experiments performed for 30 minutes at 425°C and 1200 psig with Ni, Mo and Pd hydrous titanates added to a slurry of bituminous coal in a coal-derived solvent demonstrated that these catalysts, with active metal loadings as low as 1%, were very effective for liquefying coal. Conversions to oil ranged from 41 to 46 wt %, dmmf coal basis. Pd hydrous titanate has also been tested for hydrogenation of a coal-derived liquid at low temperatures and pressures. Use of the Pd hydrous titanate allowed quantitative conversion of the polynuclear aromatics components of liquid to hydroaromatics at a temperature of 100°C and hydrogen pressure of 100 psig. The results of these and other experiments with this novel class of catalysts are described, and the application of hydrous metal oxide ion exchangers to direct coal liquefaction technology is discussed.

22102 (CONF-8511136—, pp III.19-III.42) **New catalysts for hydrotreating coal liquids.** Hirschon, A.S.; Wilson, R.B. Jr.; Laine, R.M. (SRI International, Menlo Park, CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FG22-83PC60781;FG22-85PC80906.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The cost of hydrotreating coal liquids or heavy crudes is considerably higher than for light crudes because of the significantly higher amounts of sulfur, nitrogen and oxygen found in these hydrocarbon sources relative to light crudes. In particular, the current processes for the catalytic removal of nitrogen (HDN) and oxygen (HDO) consume excessive amounts of hydrogen due to concurrent hydrogenation of aromatics. The ideal HDN or HDO catalyst would be one that selectively cleaves C-N or C-O bonds with minimum consumption of hydrogen. This would reduce the overall hydrotreating costs for refining crude oil and could make synfuels a competitive energy source. In this paper, the investigators discuss the results of two approaches to the development of improved HDN catalysts. One approach focusses on the synthesis of high-activity, highly dispersed, "surface confined", catalysts using organometallic complexes. The other approach examines the hydrotreating activities of metals not currently used in HDN and HDO catalysis. This latter investigation arises as a consequence of their efforts to develop mechanistic models of HDN through studies of the homogeneous catalysis of the transalkylation reaction, and through studies of quinoline HDN by bulk metals. In both the transalkylation and the bulk metal studies, ruthenium exhibits the highest activity for C-N bond cleavage. This suggests that it may be useful as an

HDN catalyst. The synthesis and HDN activities of catalysts prepared according to the principles established by these two separate approaches are described. 4 refs., 7 figs., 3 tabs.

22103 (CONF-8511136—, pp III-43-III.61) **Improved catalysts for coal liquefaction.** Baker, J.R.; McCormick, R.L.; Haynes, H.W. Jr. (Univ. of Wyoming, Laramie). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The Temperature Programmed Desorption (TPD) of t-butylamine has proven to be a valuable tool for characterizing the acidity of hydrotreating catalysts. The primary source of acidity on these catalysts is molybdenum, as either the oxide or sulfide. The TPD results indicate that both the number and strength of acid sites on a typical molybdena-alumina catalyst may exceed same on a typical silica-alumina cracking catalyst. The effects of various promotors - nickel, cobalt, sodium, magnesium and phosphorous - on catalyst acidity are described. Some hydrotreating results are reported for a commercial catalyst, Shell 324M. These results indicate that the feedstock originally selected for this study is too rich in hydrogen. A thermodynamic limitation makes it impossible to add substantial quantities of hydrogen to the liquid. Since hydrogenation is the primary reaction of interest we are in the process of selecting a more hydrogen deficient feedstock for our deactivation studies. The hydrotreating unit is now fully operational. 18 refs., 9 figs., 3 tabs.

22104 (CONF-8511136—, pp III.62-III.75) **Coal conversion and hydrogen utilization in catalytic liquefaction at low temperatures.** Bockrath, B.C.; Finseth, D.H.; Illig, E.G. (Dept. of Energy, Pittsburgh, PA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The initial stages of coal liquefaction have been investigated in small batch autoclaves at moderate to low liquefaction temperatures. Conventional liquefaction in an organic recycle solvent was compared with liquefaction of coal in water. In conventional liquefaction, the majority of the tetrahydrofuran conversion ultimately obtained at long reaction times had already appeared before 15 minutes or less had elapsed at the set temperature. Addition of ammonium molybdate had a beneficial effect on conversion at lower temperatures as revealed by a decrease in the demands placed on the liquefaction solvent. The use of a catalyst under hydrogen pressure may compensate for the suppression of conversion values normally associated with using substantially smaller amounts of liquefaction solvent. The utilization of hydrogen was determined by elemental and NMR analyses of the organic portion of the entire charge fed to and taken from the autoclave. The net change in hydrogen per 100 carbons was calculated for four categories: hydrogen gas make, heteroatom removal, change in aromaticity (hydrogenation/dehydrogenation), and matrix bond cleavage/condensation. Hydrogen consumption is observed below 400°C in the hydrogenation of aromatic carbon. However, above 400°C, dehydrogenation reactions predominate and hydrogen is released in this category rather than consumed. These results show that the choice of liquefaction temperature, catalyst, solvent, and pressure of reducing gas may be used to control the pattern of hydrogen utilization. 8 refs., 5 figs., 5 tabs.

22105 (CONF-8511136—, pp III.76-III.102) **The activity of functionalized-carbon supported catalysts for coal asphaltene conversion.** Abotsi, G.M.K.; Scaroni, A.W.; deBeer, V.H.J.; Solar, J.M.; Skrovanek, D.J.; Derbyshire, F.J. (Pennsylvania State Univ., University Park). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-83PC60050.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Carbon supported catalysts have been reported to possess high activities for hydrogenation, hydrodesulfurization and asphaltene conversion. In addition, in comparison to alumina supported catalysts, they possess low propensities for promoting coke-forming reactions. It is also known that catalytic activity can be enhanced by the prior introduction of functional groups onto the carbon surface. In order to systematically investigate the effects of carbon surface functionality on catalytic activity, a single, high purity carbon (Ambersorb XE-340) has been selected and treated in various oxidizing agents and in ammonia (at 400 and 600 C) in order to introduce oxygen and nitrogen surface functionalities. The carbons were then loaded with 3% wt Mo from an aqueous solution of ammonium tetrathiomolybdate. The loaded and unloaded supports were subjected to examination by FTIR. The catalysts were examined for their activities for coal asphaltene conversion. The results show that catalysts prepared on the nitrided supports possessed the highest activity for coal asphaltene conversion, while producing relatively low gas and coke yields. The activity of the catalysts increased with the nitrogen content of the supports. In contrast, catalysts prepared on the oxidized samples showed a reduction in activity over the untreated support. The lower activity of acid-treated supports can be explained in terms of their loss of surface area. Preoxidation with $KMnO_4$ and $K_2Cr_2O_7$ may reduce catalytic activity through destroying or modifying surface sites which can favorably interact with Mo species. 4 refs., 12 figs., 2 tabs.

22106 (CONF-8511136—, pp III.103) **Structural mobility in coal dissolution.** Sprecher, R.F.; Lett, R.G.; Retcofsky, H.L. (Dept. of Energy, Pittsburgh, PA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The mobility of liquefaction solvent molecules in the coal matrix and the flexibility of the coal matrix itself both have a bearing on the nature of the available pathways for liquefaction. The transport of reactants into and products out of the coal matrix during the early stages of liquefaction will have a profound influence on the course of subsequent reactions during later stages of liquefaction. If retrogressive reactions are to be avoided, radical capping agents must be transported to reactive sites and polyfunctional products which might serve as cross-linking agents must be diluted or removed from active sites. The mobility of solvents in the matrix can be understood in terms of the motions available to paramagnetic solutes as reflected in electron spin resonance (ESR) measurements at a variety of temperatures. The flexibility of the coal matrix itself can be monitored by in-situ solid state carbon-13 nuclear magnetic resonance (NMR) methods. Changes in the ^{13}C dipolar-dephasing time constants occur with temperature which signal the onset of large amplitude librations in the various parts of the coal matrix. The ESR measurements indicate that the average particle size in a reacting coal slurry undergoes a dramatic reduction at the onset of the reaction and then increases again later in the dissolution. The microscopic viscosity of the liquid does not seem to change much in the course of dissolution. This behavior is consistent with the viscosity increases observed in the preheater stage of some coal liquefaction experiments. The NMR measurements to date indicate that a coal matrix swelled by a solvent is somewhat more rigid than the original coal matrix at room temperature.

22107 (CONF-8511136—, pp IV.1-IV.31) **Organic vehicle, catalyst, water: Interplay of three aids to coal hydroliquefaction.** Ruether, J.A.; Mima, J.A.; Kornosky, R.M. (Dept. of Energy, Pittsburgh, PA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Hydroliquefaction of Illinois 6 has been investigated in the presence of water, organic vehicle, and catalyst, a water-soluble molybdenum salt. At otherwise constant reaction conditions, all three additives increase conversion both when used singly and in combination. In the presence of water, or water and catalyst, the full beneficial effect of organic vehicle on conversion is obtained at low vehicle/coal ratios. THF conversions of over 90% are realized at vehicle/coal ratios as low as 0.25. Water also has the effect of reducing the sensitivity of conversion to the hydrogen-donor quality of the vehicle. Operation near the critical temperature or critical density of water is not necessary.

22108 (CONF-8511136—, pp IV.32-IV.42) **Supercritical water/CO liquefaction and a model for coal conversion.** Ross, D.S.; Hum, G.P.; Miin, T.C.; Green, T.K.; Mansani, R. (SRI International, Menlo Park, CA; Western Kentucky Univ., Bowling Green, KY; Eniricerche S.p.A, Milan, Italy). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The studies reported here deal with research on the kinetics and mechanism of conversion, using supercritical water as the medium. The work in hydrothermal conversion, in which CO provides the reducing potential, follows the pioneering research of Fischer and Schrader early in this century, and the more recent work of Appell et al. In accord with these earlier studies, the investigators have demonstrated that the conversion is promoted by base, and is a function of the pH of the starting water. Water is ideal as a conversion medium, particularly for mechanism studies. Unlike common organic donor media, it is not adducted into the products. Moreover, since water displays an affinity for hydrocarbons at temperatures above about 300°C, it is expected to wet the coal as well as an organic medium does, and act as a good solvent for the products. 6 refs., 5 figs.

22109 (CONF-8511136—, pp IV.43-IV.46) **New CO/water conversion of coal.** Del Bianco, A.; Girardi, E. (Eniricerche, Milan, Italy). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Recent developments from this work suggest that major improvements over the conventional donor solvent staged coal liquefaction are possible. First, it has been shown experimentally that the CO/water system is inherently superior to conventional donor solvent systems because retropolymerization reactions can be better controlled and no recycle of organic solvents is necessary. Moreover, we suppose that syngas can be utilized in an optimum way, i.e., CO in the liquefaction and H_2 in the upgrading step. We present a research program focussed on the development of a conversion system based on these elements. A simplified block diagram of an hypothetical process founded on this liquefaction concept is shown in figure 1: the liquefaction unit operating at suitable values of temperature and pressure and fed with coal, syngas, water and a suitable water-soluble catalyst; the liquid-solid separation unit, where unreacted coal and ashes are separated from water and oil; the gasification unit, where the liquefaction residue is utilized to produce CO/H_2 as reducing gas in the process; the water-oil separation unit, from which the organic liquid is fed to the upgrading reactor, while the water is recycled to the liquefaction unit; and the gas treatment unit for the separation and purification of the hydrogen to be used in the upgrading step. The project is planned for a period of three-years and is divided into three tasks: (1) CO/water system; (2) product upgrading and evaluation; and (3) conceptual process design. 1 fig.

22110 (CONF-8511136—, pp IV.47) **Novel liquefaction solvent: H_2O-H_2S.** Stenberg, V.I. (Univ. of North Dakota, Grand Forks). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Water and hydrogen sulfide are successfully substituted for organic liquids for the liquefaction of six samples of three ranks of coal in autoclave studies. The yields of volatile products are best when the temperature is programmed from 300 to 500°C. The H_2O-H_2S solvent system addresses the apparently insoluble problems which the organic solvents for coal liquefaction pose. These problems are the slow rehydrogenation of the oxidized organic solvent (after hydrogen donation), the disappearance of good hydrogen-donating solvent molecules into the non-solvent coal fractions during repeated cycles of the solvent, and the isomerization of good organic hydrogen donor molecules into poorer hydrogen-donating species during liquefaction. The comparison results using the solvents H_2O, H_2O-H_2S, dihydrophenanthrene (DHP) and anthracene oil (AO4) with solvent refined coal middle distillate (SRCMD) have been done. The DHP runs gave better conversions than either water or AO4-SRCMD gave in otherwise the same experimental conditions. However, DHP decomposed to the extent of 11% at 420°C at 30 minutes, and the non-gaseous products were solids at room temperature rather than liquids as they were with the water runs. The water runs were the easiest to separate from the product slurry. The distillation was complete in 5 hours with the water runs, whereas it took from 7 hours to get to constant weight with the organic solvent-based runs. The oil separated from the water by gravity in the water-based reaction distillates. Catalysts have been designed, synthesized and tested for use in the H_2O-H_2S solvent. The metals and metal sulfides used are: Mn, Fe, Co, Ni, Cu and Zn. The metal sulfides outperform the metals for improving the conversion yields, and both improve the yields of light oil at the expense of heavy oil.

22111 (CONF-8511136—, pp IV.48-IV.64) **Degradation of lignite coal by Polyporus versicolor: Initial characterization of products.** Cohen, M.S.; Aronson, H.; Gray, E.T. Jr. (Univ. of Hartford, West Hartford, CT). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FG22-84PC70806.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Lignite coal has been degraded to a black liquid product (the bioextract) by action of the fungus Polyporus versicolor. The products have been partially characterized through analysis by HPLC, and both NMR and ir spectroscopy. Liquefaction of coal was visually apparent within 24 hours after the coal was added to the fungal cultures. The bioextract was insoluble in hexane, methylene chloride, and 1-butanol; partially soluble in THF, 1-propanol, ethanol, and acetonitrile; and soluble in methanol and water. The soluble fractions were analyzed by HPLC on a C_{18} column. In general, the higher the polarity index of the solvent, the greater the amount of dissolved bioextract. NMR spectroscopy of the bioextract showed that 75% of the hydrogen present in the sample resides in functional groups such as organic acids, amines, alcohols, and sulfhydrals, rather than on the remnants of the carbon backbone of the lignite. These results are supported by ir spectroscopy. In both NMR and ir analyses, absorbances that would result from the presence of polycyclic aromatic hydrocarbons in pyrolized coal were absent from the bioextract. 16 refs., 3 figs.

22112 (CONF-8511136—, pp IV.65-IV.87) **Microbial coal liquefaction.** Scott, C.D.; Strandberg, G.W. (Oak Ridge National Lab., TN). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC05-84OR21400.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The production of apparent coal-derived, water-soluble products occurs when certain microorganisms are cultured in the presence of low-ranked coal. The potential utility of these organisms to convert coal to useful liquid products is being investigated. Particular emphasis is being placed on determining the operating parameters that affect liquefaction, on establishing the characteristics of the liquid products, and on studying potential process approaches that could be used for large-scale operation. Various fungi appear to be the most active organisms and several species have been found associated with lignite in the natural state. Lower-ranked coals seem to be better substrates, although biological action on one subbituminous coal was observed. Liquefaction rate appears to be related to the oxidation state of the coal, as well as other chemical characteristics. The liquid product is not well defined, but it includes a large number of soluble molecular constituents, some of which may have moderate to high molecular weights. Most work has been carried out with surface cultures; however, several different types of organisms can be induced to attach to the solid surface of coal when in suspension culture. The latter may represent the mode of operation for a large processing system. 9 refs., 7 figs., 5 tabs.

22113 (CONF-8511136—, pp V.1-V.17) **Status of Lummus Crest Inc. research and development program on coal liquefaction co-processing.** Greene, M.; Gupta, A.; Moon, W.; Schiffer, A. (Lummus Crest Inc., Bloomfield, NJ). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-84PC70042.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Lummus Crest Inc. (LCI), a subsidiary of Combustion Engineering Inc., entered into a contract with the US Department of Energy for the performance of an R and D program aimed at evaluating the co-processing route to coal liquefaction. In co-processing, low grade petroleum-derived feedstocks, which are still richer in hydrogen content than coal, are used to form a coal slurry. The resultant slurry is then processed in an integrated, close-coupled, two-stage liquefaction system, thereby minimizing costly solvent recycle. The LCI co-processing concept meshes ITSL technology for coal liquefaction together with resid upgrading by expanded-bed hydrocracking (LC-FINING). The LCI co-processing concept features a number of desirable characteristics: results in a beneficial synergism between aromatic-rich coal extracts and their ability to solubilize and stabilize hydrocracked petroleum resid species; results in high hydrogen efficiency, i.e., yield of distillate per weight of hydrogen consumed; eliminates the costly expense of deashing coal liquefaction products; generates a product slate enriched in distillates; provides feedstock flexibility with respect to coal/petroleum feed rates and petroleum source; and overcomes operating problems associated with coking and fouling of process lines, vessels and catalysts. 2 figs., 4 tabs.

22114 (CONF-8511136—, pp V.18-V.55) **Coal liquefaction co-processing.** Gatsis, J.G.; Sikonia, J.G.; Nelson, B.J.; Luebke, C.P.; Humbach, J. (Signal Research Center Inc., Des Plaines, IL; UOP Inc., Des Plaines, IL). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-84PC70002.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

As an important part of our national goal to broaden the source of feedstocks used for the production of high quality transportation fuels, increased utilization of lower quality petroleum resids and coal is desired. The conversion of these materials, separately, into high quality products has been shown to be difficult and expensive. The objective of this study is to determine if a proprietary UOP catalyzed, single-stage slurry process involving the simultaneous conversion of resid and coal offers the potential for improved economics. The overall objectives are to evaluate the technical feasibility and to establish a process data base on the co-processing concept. The single-stage, slurry-catalyzed co-processing concept was demonstrated successfully in laboratory batch experiments. The active UOP catalyst gave high coal conversion and high conversion to liquid product at relatively low temperature and, as a result, the thermal degradation reactions and cracking of resid- and coal-derived liquid to light gases were minimized. The liquid hydrocarbon product is of high quality and can be utilized efficiently as a feedstock in existing refineries. 14 figs., 5 tabs.

22115 (CONF-8511136—, pp V.56-V.82) **CANMET co-processing of low-rank Canadian coals.** Fouda, S.A.; Kelly, J.F. (CANMET, Energy, Mines and Resources Canada, Ottawa). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

An extensive research program is underway at CANMET on the simultaneous liquefaction of coal and upgrading of heavy oil or petroleum residues. CANMET coprocessing is a single-stage once-through process that utilizes an inexpensive disposable catalyst. It can be viewed as an extension of the CANMET hydrocracking process with high coal concentration in the slurry feed. The feasibility of CANMET coprocessing was tested for a number of coals and residues to assess their suitability as coprocessing feedstocks and to generate a database of the product yield structure for each coal. The process performance using different feedstocks is compared. Using Cold Lake vacuum bottoms as a coprocessing medium, eight coal feedstocks were investigated. The process was feasible for all the coals with marginal variations, among the low rank coals, in the distillate yields and qualities and in the coal conversions. Similarly, using an Alberta subbituminous coal, the process was shown to be feasible for the residues tested. It was found that the residues originating from bitumens/heavy oils result in higher pitch conversions and higher distillate yields than those originating from conventional crudes. The distillates produced from conventional crude residues, however, are of a better quality than those produced from bitumen/heavy oil residues. 2 refs., 4 figs., 14 tabs.

22116 (CONF-8511136—, pp V.83-V.95) **HRI [Hydrocarbon Research, Inc.] coal/oil co-processing program: A status report.** MacArthur, J.B. (Hydrocarbon Research, Inc., Lawrenceville, NJ). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Coal/oil co-processing has the potential to significantly reduce the cost of liquid fuels from coal or heavy oil. Hydrocarbon Research, Inc. (HRI) is developing an advanced two-stage co-processing process to liquefy coal while upgrading heavy crudes or petroleum residua. A program has been initiated featuring microautoclave and autoclave reactivity screening studies and continuous bench unit operations on several coal/oil pairs. Assessments are also being made as to the preferred commercial application of the coprocessing technology. This work is being done under the sponsorship of several parties including Electric Power Research Institute, Ontario-Ohio Synthetic Fuels, Inc., Alberta Research Council, and Dynalectron Corporation. A brief program description and status report is presented. 4 refs., 3 figs., 3 tabs.

22117 (CONF-8511136—, pp V.96-V-119) **EPRI [Electric Power Research Institute] coal liquefaction program.** Lebowitz, H.E. (Electric Power Research Institute, Palo Alto, CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The EPRI coal liquefaction program was started in 1974 to help solve the oil supply shortage of the 1970s, and to assure a reliable supply of fuel oils for electric utilities. EPRI participated as a partner with government and industry in the major liquefaction projects of that era. EPRI's interest in coal liquefaction, as a whole, and in direct liquefaction, in particular, has waned in recent years as the utilities have reduced their fuel-oil consumption. Further, the price and supply of fuel oil have stabilized at levels which are not conductive to commercialization of direct liquefaction. EPRI's current involvement in direct liquefaction is limited to development of two-stage liquefaction at the Wilsonville facility. Two Stage Liquefaction is of interest because it allows for production of heavy distillates, in reasonable quantities, which are of a suitable nature for use as fuels (low nitrogen and sulfur). Indirect liquefaction has taken on an increased prominence in the EPRI program, with the acceptance of Integrated-Gasifier-Combined-Cycles (IGCC) for power generation. Once-Through Methanol is an attractive concept for production of methanol by partial conversion of the gasifier product. EPRI is also participating in the HRI coal heavy-oil co-processing project. Like two-stage liquefaction, co-processing produces high yields of attractive products for utilities, as well as premium transportation fuels.

22118 (CONF-8511136—, pp VI.1-VI.28) **Integration of advanced coal preparation and liquefaction.** Longanbach, J.R.; Steedman, W.G. (Battelle Columbus Div., OH). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Actual improvements in the coal used for coal liquefaction which appear to be achievable based on the results of this program may be summarized as follows: ~50% of the mineral matter can be removed via this sequence of steps with the limit set by fine grinding. Chlorine levels can be lowered to 50 to 100 ppM easily and this should result in decreased corrosion. Pyrite retention is excellent and more than 90% of the pyrite in the washed coal should be retained. Disposable catalysts can be incorporated in the coal, but it was not established that they could be retained in the coal through the entire processing sequence. Btu recovery is excellent. With subbituminous coal, hot-water-treatment significantly decreases oxygen content, raising the Btu content of the coal going to the liquefaction reactor and decreasing hydrogen demand, a significant advantage. Oxidation of coal may be decreased but was not avoided by wet grinding. Solvent drying of subbituminous coal does improve

reactivity, but does decrease the thermal load on the process by making efficient use of the heat in the recycle solvent. Almost all of the calcium can be removed from subbituminous coal via ion exchange, resulting in significantly reduced operating problems for the liquefaction of subbituminous coal. Drying of subbituminous coals can be done without the risk of fires. A better coal for liquefaction can be prepared via this process. 5 figs., 8 tabs.

22119 (CONF-8511136—, pp VI.29-VI.45) **Effect of various drying methods and levels on the conversion of low-rank coals.** Jones, F.A.; Ness, R.O.; Hetland, M.; Rindt, J.R. (Univ. of North Dakota Energy Research Center, Grand Forks). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FC21-83FE60181.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The liquefaction conversion of three low-rank coals (LRC) were determined using three drying methods and varying process severity. The low-rank coals used in this study were Wyodak (Wyoming) subbituminous, Indian Head (North Dakota) lignite, and Morwell (Australian) brown coal. The coals were dried using air, hot solvent, and hot water methods so that the feed coal was either completely dry (100% dried) or had a moisture content half that of the as-received coal (50% dried). Under mild-severity liquefaction conditions both the Wyodak subbituminous and Indian Head lignite coals showed decreased overall conversion with drying, irrespective of drying method. The brown coal showed an increase in reactivity for all cases except at 100% dryness. The largest decreases in reactivity were observed when air or oil drying was extreme (100% dryness) or when hot-water drying was used. When Wyodak and the Indian Head coals were completely dried in air and oil, and then moisture was added to a level equivalent to that of the as-received coal, the reactivity was restored to that of the original coal. This supports data obtained at UNDERC during hydrothermal treatment for LRC-water slurry preparation, which showed that temperatures in excess of about 270°C, pyrolysis conditions, were necessary to yield a product that did not reabsorb moisture to its equilibrium level. Under severe liquefaction conditions, drying increased overall conversion, but the yield of liquid product remained early constant. The product slurry contained higher ratios of distillate to soluble residuum as the water content increased, although the total liquid product yield remained constant. 6 refs., 12 figs; 2 tabs.

22120 (CONF-8511136—, pp VI.46-VI.57) **Coal pretreatment for two-stage liquefaction.** Luckie, P.T.; Derbyshire, F.J. (Pennsylvania State Univ., University Park). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The overall objective of this research project is to investigate the effects of coal feedstock pretreatment on two-stage coal liquefaction. This is being achieved by determining the effect of varying inorganic and/or organic composition and process variables. Fundamental to varying composition is the liberation achieved during feedstock comminution. This paper reviews the liberation patterns observed for a high volatile bituminous coal and sub-bituminous coal when subjected to systematic size reduction as indicated by the resulting washability analyses. The pretreatment procedures followed to prepare coal liquefaction feedstock can influence the feedstock composition, hence experimental results. Examination of the liberation pattern of macerals has shown that maceral liberation is not conventional, defined as increasing lighter density particles accumulating during random fracture. In addition, it appears that the float-and-sink analysis procedure can also influence the composition; further studies are necessary to explain why this is so. A suggested rule-of-thumb for coal liquefaction researchers would be to always prepare their samples in the same manner. Simply grinding the remaining oversize coal sample some more and floating the resulting undersize material at 1.5 can produce a different feedstock material which may lead to different testing results. 7 refs., 3 figs.

22121 (CONF-8511136—, pp VI.95-VI.116) **Hydrogenolysis in coal liquefaction and pyrolysis: The relative importance of solvent radicals and free hydrogen atoms.** McMillen, D.F.; Malhotra, R.; Nigenda, S.E. (SRI International, Menlo Park, CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FG22-84PC70810;AC22-81PC40785.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

This presentation incorporates most of the results described in the ACS Fuel Division Preprints (Vol. 30, No. 4, 297 (1985)), as well as additional results from the numerical modeling of solvent-induced bond scission. Evidence is summarized that the ability of donor-solvent systems to engender scission of strong bonds in coal structures is the critical factor that determines the effectiveness of liquefaction solvents. Hydrogen-transfer processes leading to bond scission were studied in pure model compound systems and in mixtures of model compounds and real coals. These studies involved, where possible, internal kinetic comparisons (product ratios) to measure the relative importance of the competing transfer processes. The results obtained in the model compound systems have been incorporated into a mechanistic numerical model for solvent-induced bond scission. This model includes the principal non-ionic, competing hydrogen transfer modes that lead to bond scission: transfer by free hydrogen atoms, transfer from hydroaromatic molecules, and transfer from hydroaromatic radicals. The latter process, which had not been previously documented, tends to be the dominant hydrogen transfer process when the ratio of aromatic to hydroaromatic is large (i.e., about 1 or 2 or greater). In contrast, transfer by free hydrogen atoms tends to dominate at very low Ar/ArH_2 ratios. The result of this competition is that when the polycyclic aromatic content of the solvent system is very low, the use of solvent- (or coal-) derived hydrogen to cleave bonds is very low; a large portion of the hydrogen is used to produce H_2 or reduced, but uncleaved coal structures. On the other hand, when the polycyclic aromatic content of the solvent is high, the fraction of hydroaromatic hydrogen consumed that goes to produce coal-structure cleavage approaches one. 16 refs., 6 figs., 1 tab.

22122 (CONF-8511136—, pp VI.117-VI.149) **Recent progress in coal liquefaction in amine systems.** Chen, W.Y. (Gulf South Research Institute, New Orleans, LA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-83PC60046.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Our liquefaction research has demonstrated the potential of the process in the following areas: primary aliphatic amines are better solvents than commonly used tetralin and THQ in terms of coal conversion, liquefaction temperature, product distillability and total gas yield, it is likely that the consumption of amine can be reduced to such a low level that an indigenously-derived solvent rich in amine can be utilized to enhance liquefaction. Both GSRI's study of primary aliphatic amine and other reported data have demonstrated that amine consumption is mainly due to the reactions between coal-derived products and amine, not between coal and amine. Coal contact time does not appear to be an important variable. In addition, other components in the solvent, such as water, can not only enhance conversion at lower temperature but also reduce amine reactions with coal. This observation leads us to believe that future work should emphasize studies of short vapor residence times and amine's role in multicomponent systems. 28 refs., 16 figs., 2 tabs.

22123 (CONF-8511136—, pp VII.62) **Chemistry and morphology of coal liquefaction.** Fish, R.H.; Heinemann, H. (Lawrence Berkeley Lab., CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The removal of nitrogen atoms from coal compounds such as polynuclear heteroaromatic nitrogen compounds, e.g., quinoline, is an extremely important process in the upgrading of coal liquids. The use of hydrogen gas is the economically limiting factor in the hydrodenitrogenation process (HDN) and a substantial savings in this reactant would have a profound effect on the processing of

these synthetic fuels. We have shown that certain homogeneous and polymer-supported transition-metal catalysts can regioselectively reduce the nitrogen-containing ring in polynuclear heteroaromatic nitrogen compounds. These dramatic results clearly indicate that hydrogen gas can be used selectively in the HDN process and that the first step in the ultimate removal of nitrogen has been accomplished. We are now focused on the removal of nitrogen as ammonia without substantial use of hydrogen gas. A two-fold approach was initiated for these HDN studies with the first being the synthesis of dimetalla-azacyclobutene compounds as models to understand the cleavage of carbon-nitrogen bonds and the second being a perusal of metals on supports, such as silica, that had high metal loadings, i.e., 30 to 50 wt %, for nitrogen atom removal from 1,2,3,4-tetrahydroquinoline under mild HDN conditions (~300°C, 1 atm H_2 gas). We have made a discovery that could have a pronounced effect on the economics of the HDN process. We found that high metal loadings on silica, with nickel (30 wt %) the most active metal, could cleave the carbon-nitrogen alkyl bond and remove the nitrogen atom as ammonia at 320°C under 1 atmosphere of hydrogen gas with 1,2,3,4-tetrahydroquinoline as the model HDN compound. These results show that a substantial savings in hydrogen gas consumption can be achieved in the HDN process, since no aromatic rings were reduced to cyclohexyl derivatives with the nickel catalyst.

22124 **(DOE/FE/05081—2197-Vol.2) Coal gasification via the Lurgi process: Topical report: Volume 2, Production of IFG [industrial fuel gas].** Zahnstecher, L.W. (Foster Wheeler Corp., Livingston, NJ (USA)). Dec 1984. Contract AC21-82FE05081. 360p. NTIS, PC A16. File Number DE87001009.

A Lurgi baseline study was requested by the DOE/GRI Operating Committee of the Joint Coal Gasification Program for the purpose of updating the economics of earlier Lurgi coal gasification plant studies for the production of industrial fuel gas (IFG) based on commercially advanced technologies. The current study incorporates the recent experience with large size Lurgi plants in an effort to improve capital and operating costs of earlier plant designs. The present coal gasification study is based upon a plant producing 73.3 billion Btu (HHV) per day of IFG using the Lurgi dry bottom coal gasification technology. A Western subbituminous coal was designated as the plant feed, obtained from the Rosebud seam at Colstrip, Montana. This study presents the detailed description of an integrated facility which utilizes coal, air, and water to produce 73.3 billion Btu (HHV) per day of industrial fuel gas. The plant consists of coal handling and preparation, seven Lurgi dry bottom gasifiers, acid gas removal, sulfur recovery, phenol and ammonia recovery, as well as necessary support facilities. The plant is a grass roots facility located in the area of Minneapolis, Minnesota. The Lurgi Corporation assisted in this study, under subcontract to Foster Wheeler, by supplying the heat and material balances, flow sheets, utilities, catalysts and chemical requirements, and cost data for Lurgi designed process sections. Details of material supplied by Lurgi Corporation are presented in Appendix A. 39 refs., 33 figs., 50 tabs.

22125 **(DOE/MC/21203—2275) Fundamental research on novel process alternatives for coal gasification: Final report.** Hill, A.H.; Knight, R.A.; Anderson, G.L.; Feldkirchner, H.L.; Babu, S.P. (USDOE Morgantown Energy Technology Center, WV; Institute of Gas Technology, Chicago, IL (USA)). Oct 1986. Contract AC21-84MC21203. 207p. NTIS MF A01; 2; GPO Dep. File Number DE87001060.

The Institute of Gas Technology has conducted a fundamental research program to determine the technical feasibility of and to prepare preliminary process evaluations for two new approaches to coal gasification. These two concepts were assessed under two major project tasks: Task 1. CO_2-Coal Gasification Process Concept; Task 2. Internal Recirculation Catalysts Coal Gasification Process Concept. The first process concept involves CO_2-O_2 gasification of coal followed by CO_2 removal from the hot product gas by a solid MgO-containing sorbent. The sorbent is regenerated by either a thermal- or a pressure-swing step and the CO_2 released is recycled back to the gasifier. The product is a medium-Btu gas. The second process concept involves the use of novel "semivolatile" materials as internal recirculating catalysts for coal gasification. These materials remain in the gasifier because their vapor pressure-temperature behavior is such that they will be in the vapor state at the hotter, char exit part of the reactor and will condense in the colder, coal-inlet part of the reactor. 21 refs., 43 figs., 43 tabs.

22126 **(DOE/MC/21315—2190) Pretreatment techniques for coal gasification. Fifth quarterly report, October 1-December 31, 1985.** Graff, R.A. (City Coll., New York (USA)). 1985. Contract AC21-84MC21315. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000620.

Pretreatment of coal in steam is being explored with the goal of improving the economic attractiveness of coal gasification by cogeneration of light liquid fuels. The final draft of a literature survey has been completed and issued. Reactor performance was examined in a series of extended runs using the coal feeder installed during the last quarter. Char deposits found on the reactor wall showed that coal was not being transported to the trap. Two internal modifications were then made to the reactor and tested in succession. The second of these, which employed a longer water cooled feed tube and an increased flow of helium through the feeder, was successful. A modified collection system was installed to condense and capture liquids from the inert gas stream. In order to trap low molecular weight liquids, a silica gel adsorber was added after the filter. More liquids are produced at lower pyrolysis temperatures, and two additional equipment modifications were required to accommodate these liquids. The cooling tube was replaced by one of larger diameter to avoid intermittent plugging by condensed liquids, and a quartz wool filter of higher capacity was added ahead of the one initially used. Thirty runs were made with both raw and pretreated coal. Diffuse reflectance infrared spectroscopy was used to analyze pretreated coal. Samples pretreated at several different temperatures were compared to raw coal and raw coal dried under vacuum at 90°C. In the region attributed to carbonyl bonds, all spectra appeared identical. In the region attributed to hydroxyl groups, however, there was a shift in the ratio of chemisorbed to physisorbed hydroxyl species. Pretreated coal contains less physisorbed hydroxyl. This finding indicates that hydrogen bonding is reduced by pretreatment. 6 figs., 2 tabs.

22127 **(DOE/MC/21315—2194) Pretreatment techniques for coal gasification. Sixth quarterly report, January 1-March 31, 1986.** Graff, R.A. (City Coll., New York (USA)). 1986. Contract AC21-84MC21315. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87000622.

Pretreatment of coal in steam is being explored with the goal of improving the economic attractiveness of coal gasification by cogeneration of light liquid fuels. The final draft of a literature survey has been completed and issued. Inert gas pyrolysis runs were made at atmospheric pressure with raw and pretreated Illinois No. 6 coal. Two coal batches showed no response to pretreatment in either pyrolysis or extraction perhaps because of oxidation during grinding. A new batch was ground, and this showed a response to pretreatment in agreement with that obtained in earlier experiments. The maximum liquid yield of 33 wt. % at 650°C is raised to 40% by pretreatment. A procedure for determination of gas yields using the on-line mass spectrometer was implemented. Material balance closures between 90 and 95% are obtained. Helium pyrolysis of raw and pretreated Illinois No. 6 coal was conducted at 200 and 500 psia. The yield of liquid product is severely depressed by increasing pressure and is not improved by steam treatment. Kentucky bituminous coal (-8 mesh) received from United Coal Co. was ground under nitrogen to pass 200 mesh. Pyrolysis tests with this coal were conducted in 20 psia helium at temperatures from 550 to 800°C. Material balance closures are 90 to 98% and averaged 93.4%. A maximum condensable yield of 28 wt % on daf coal is obtained at 650°C. Room temperature pyridine extracts from raw and pretreated Illinois No. 6 were fractionated according to molecular weight and functionality using liquid chromatography. Extract from pretreated coal contains less polyfunctional material, more basic nitrogen species, and more oxygen containing species. The former results suggest cleavage of multifunctional components, the latter may arise from oxidation of the extracts during handling. 6 figs., 8 tabs.

22128 **(DOE/MC/21315—2195) Pretreatment techniques for coal gasification. Eighth quarterly report, July 1-September 30, 1986.** Graff, R.A. (City Coll., New York (USA)). 1986. Contract AC21-84MC21315. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000623.

Pretreatment of coal in steam is being explored with the goal of improving the economic attractiveness of coal gasification by cogeneration of light liquid fuels. Steam pyrolysis of raw Illinois No. 6 coal at atmospheric pressure was tested in ten runs. A maximum liquid yield of 30% is obtained at 550°C. Nine runs were conducted with pretreated Illinois No. 6 coal. A pronounced pretreatment effect is observed. The maximum liquid yield is raised to 39 wt % (an increase of 30% over that for raw coal) at a pyrolysis temperature of 550°C. 2 figs., 3 tabs.

22129 **(DOE/MC/21315—2297) Techniques for coal gasification: Final report.** Graff, R.A.; Zhou, P.; Brandes, S.D. (City Coll., New York (USA)). Dec 1986. Contract AC21-84MC21315. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001081.

Conditioning of coal in steam is being explored with the goal of improving the yield and quality of condensable hydrocarbon product obtainable by mild gasification. A literature review shows that temperatures between 300 and 350°C are promising for this purpose. In this range there is evidence that coal is thermally labile and that steam can dissolve in and react with coal. Experiments were conducted using a semicontinuous bench scale reactor processing up to 2.5 grams per run. Raw and conditioned samples of Illinois No. 6 coal were mild gasified in steam at atmospheric pressure and in inert gas at pressures up to 500 psia. Atmospheric pressure tests under inert gas were carried out with raw Kentucky bituminous coal, steam conditioned coal, and coal mixed with hydrated lime. When Illinois No. 6 coal is mild gasified in either inert gas or steam at atmospheric pressure, conditioning at 340°C for 15 min. in 50 atm. steam increases the yield of condensable product by 30%. The corresponding result in inert gas for this sample of Kentucky bituminous coal is 5%. Considerable progress has been made in understanding the steam conditioning effect through comparative studies of steam conditioned, helium conditioned, and raw samples of Illinois No. 6 coal using solvent extraction, diffuse reflectance infrared spectroscopy, and solvent swelling. Extraction of steam conditioned coal with pyridine at room temperature gives twice the extract yield obtained from raw coal and in all respects parallels the results from mild gasification. Steam conditioning greatly increases the swelling of coal in water and water miscible solvents, but not in water immiscible solvents, and shows changes in the infrared spectrum only in the region attributed to hydroxyl groups. An interpretation of these results is that new hydroxyl groups are formed during steam conditioning at sites which in the starting coal are covalently bound. 97 refs.

22130 **(DOE/PC/70810—4) Solvent-mediated hydrogenolysis in coal liquefaction: Quarterly report No. 4 for the period September 16, 1985 to July 15, 1986.** McMillen, D.F.; Malhotra, R.; Nigenda, S.E. (SRI International, Menlo Park, CA (USA)). 12 Mar 1987. Contract FG22-84PC70810. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007116.

The objective of the present study is to explore the relevance of solvent-mediated hydrogenolysis to coal liquefaction. To this end we have investigated the cleavage rates of suitable model compounds in a variety of solvent systems with and without added coals, and assessed the relative importance of hydrogenolysis via free H-atoms and via radical hydrogen-transfer (RHT). We have been able to differentiate between hydrogenolysis via free H-atoms from that via RHT by examining the selectivity of cleavage of 1,2'-dinaphthylmethane. To further aid our understanding of the competition in cleavage of strong bonds by various modes of H-transfer, we have also conducted some mechanistic modeling studies. Finally, we are also trying to understand the impact of mass transport limitations that are likely to be important in actual coal liquefactions because of the heterogeneous nature of coal. Our approach is to bond model structures onto silica gel and study their cleavage in aromatic solvents in the presence of coal. In these experiments, the model structures, whose cleavage can be precisely monitored, cannot directly migrate to sites in coal where hydrogen becomes available, but must rely on the shuttling ability of the aromatic solvent. In this report we discuss our results of modeling cleavage of strong bonds in aromatic/hydroaromatic mixtures. During this reporting period we have optimized parameters for the RHT reactions, extended the model to the phenanthrene system, and rationalized some of the observed trends. The report also includes a brief description of our attempts to bond organic structures to silica. These materials will be used in liquefaction experiments to test the shuttling ability of different solvents. 12 refs., 3 figs., 1 tab.

22131 **(DOE/PC/70812—10) Improved catalysts for coal liquefaction: Quarterly report No. 10 for the period November 30, 1986 to February 28, 1987.** Haynes, H.W. Jr.; McCormick, R.L. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 24 Mar 1987. Contract FG22-84PC70812. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007114.

One deactivation run was completed during the last quarter using a catalyst prepared from a Harshaw/Filtrol titania support (JK02). This catalyst had a much lower surface area than the benchmark commercial catalyst (Amocat 1A) and consequent lower hydrogenation activity. The JK02 catalysts maintained its activity very well however and deactivation paralleled that of the benchmark catalyst. Silica-magnesia and nitrided activated carbon were tested as catalyst supports in batch reactor initial activity studies. Silica-magnesia did not perform well but a nitrided activated carbon supported catalyst has been selected for activity maintenance testing in the next quarter. 10 refs., 5 figs., 11 tabs.

22132 **(DOE/PC/80518—T6) Surface chemistry of model Co-Mo catalysts supported on planar gamma-Al/sub 2/O/sub 3/: Quarterly technical progress report for period December 1, 1986 to February 28, 1987.** Sahin, T.; Ford, W.K. (Montana State Univ., Bozeman (USA)). [nd]. Contract FG22-85PC80518. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007111.

This quarter, analysis of the angle resolved XPS data from a $CoMo/Al_2O_3$ catalyst characterized last quarter by XPS was completed. Preparation of the SIMS/TPD chamber for the adsorption and reaction kinetics studies have been completed and preliminary test runs have been conducted. The computer interface have been installed, and debugging and modification of the software have continued. The future work for the next quarter includes the continuation and completion of planar model catalyst development and adsorption studies. Necessary arrangements are made with the CRISS (center for research in surface science) lab to complete the characterization and development of the planar model catalysts. 5 refs., 2 figs.

22133 **(DOE/PC/80913—T1) Biodegradation and bioconversion of coals by fungi: Technical report No. 6 for the period December 1, 1986-February 28, 1987.** Ward, B. (Mississippi Univ., University (USA). Dept. of Biology). Feb 1987. Contract FG22-85PC80913. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007109.

We continued our tests for biosolubilization activity on lignite, subbituminous, and bituminous coals, using both surface solubilization and agar diffusion assays for selected lignite-solubilizing strains challenged with untreated and treated coals shown in earlier tests to be resistant to biosolubilization. These latter were subjected to treatments with heat or pressurized oxygen atmosphere, or to combinations of the same. We have observed biosolubilization of some weathered high-rank coals by some of the fungal isolates tested. 1 tab.

22134 **(DOE/PC/81543—T2) Immobilized coal-like structures: Final report, August 8, 1985 to August 7, 1986.** Bittner, E.W. (Pennsylvania State Univ., McKeesport (USA)). 1986. Contract FG22-85PC81543. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006752.

The work which was undertaken in this research commitment concerned the partial elucidation of the mechanism of reactivity of radicals present in the coal liquefaction process. During thermolysis of coal, many reactive radical sites are produced of which some are free to diffuse into the bulk of the solvent and some are

immobilized due to their covalent attachment with the macro-molecular structure. It is this latter group which are of primary interest to this particular study in that the immobilization may alter the reactive pathways of such radicals and hence effect product distributions. The purpose of this research project is to mimic these immobilized coal radicals by producing them in a much simpler model system more amenable to study. The study of such simple surface immobilized precursors under thermolytic conditions would shed light into the understanding of the nature of radical pathways in coal liquefaction. The objectives of this proposal are (a) to contribute to the knowledge regarding the mechanism of coal liquefaction via radical pathways and (b) to further understand the role of both mobile "free radicals" and surface immobilized radicals as they pertain to coal liquefaction and products obtained therefrom. Specifically, the goal of this proposal is to prepare and demonstrate the existence of surface immobilized radicals. The scope of the work involved in this project includes: (a) the preparation and analysis of silica-immobilized radical precursors; (b) the thermolysis of these immobilized precursors; and (c) the demonstration of the existence of surface immobilized radicals. 4 refs., 1 fig., 2 tabs.

22135 **(DOE/PC/90538—2) Use of basic nitrogen to chemically clean coal: Quarterly report No. 2 for the period December 16, 1986 to March 15, 1987.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 24 Mar 1987. Contract FG22-86PC90538. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007108.

During the second quarter of this project, efforts were directed toward establishing the effect of reaction temperature and coal moisture content on sulfur removal from a North Dakota lignite, a Wyoming subbituminous coal and a Kentucky bituminous coal under a hydrogen atmosphere using relatively mild coal liquefaction reaction conditions. The results obtained from microautoclave desulfurization experiments suggest that sulfur is more readily removed from the subbituminous coal than from the lignite or the bituminous coal. While increasing reaction temperature from 600° to 700°F had a significant effect on the desulfurization of the bituminous coal, there was no statistically significant effect of reaction temperature on the desulfurization of either the lignite or the subbituminous coal. The effect of moisture content on the extent of sulfur removal from the coals studied was complicated by the fact that the equilibrium moisture content of the bituminous coal was only 2.0 wt %. Water added to the bituminous coal desulfurization experiments to simulate the water which would be expected to be produced from an as-received coal did not enhance the desulfurization of this coal. 3 tabs.

22136 **(DOE/PC/90910—2) Enhanced coal liquefaction by low-severity catalytic reactions: Technical progress report for the period December 1986 to February 1987.** Davis, A.; Derbyshire, F.J.; Schobert, H.H. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Mar 1987. Contract FG22-86PC90910. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006280.

The objective of this investigation is to examine the potential and limitations of temperature-staged catalytic liquefaction. Experiments have been planned to examine the chemical reactions which occur during the low- and high-severity stages, the effects of coal rank and process conditions, the function of catalyst and influence of solvent donor capability. Initial experiments have been conducted using a lignite, subbituminous B, hvC and hvA bituminous coals. Experimental conditions were varied by using separate single low and high severity stages and a two-stage liquefaction sequence. Although no catalyst or solvent were used in these experiments, the atmosphere was systematically changed, using either hydrogen or nitrogen. From the low-severity single-stage reations (275°C) it appears that the atmosphere has negligible effects on the product distributions. Reaction variables had a greater influence in the single-stage high severity (425°C) runs and a temperature sequence, the highest conversions being obtained in the latter. As expected, the presence of nitrogen in either the high-severity single- or two-stage reactions significantly lowered the percentage conversions when compared to the presence of H_2 atmosphere in otherwise similar runs. Eleven model compounds, representing structures which could exist in coal, were hydrogenated either in the presence or absence of a molybdenum sulfide catalyst. Reaction products were analyzed by gas chromatography and characterized by the number of fragments that differ in boiling point relative to unreacted material. It was found that, under the reaction conditions employed, the catalyst can be effective in hydrogenating condensed aromatics, cleaving certain bridging linkages, and stabilizing other bond types. 24 refs., 7 figs., 7 tabs.

22137 **(EPRI-AP—5030) Characterization of KILnGAS wastewater: Final report.** Walker, J.F.; Brown, C.H.; Villiers-Fisher, J.F. (Oak Ridge National Lab., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87006951.

Samples of wastewater obtained from the 600-ton/day KILnGAS Demonstration Plant at Alton, Illinois, were obtained during plant operation in December of 1984. The samples were preserved and sent to Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, where they were subjected to detailed characterization. The results of these analyses indicate that the KILnGAS wastewater is similar to many other moving-bed gasification wastewaters. Subject to experimental verification, these results indicate that KILnGAS wastewater treatment should be possible by conventional technology.

22138 **(EPRI-AP—5048) Potential uses for the slag from the Cool Water demonstration plant: Final report.** Deason, D.M.; Choudhry, V. (Praxis Engineers, Inc., Milpitas, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 95p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920268.

Coal gasification processes produce waste materials which represent a significant expense in both disposal costs and real estate requirements. Other coal combustion wastes, such as fly ash, bottom ash, and boiler slag, are increasingly being used in construction applications. Similarly, there is considerable potential for utilizing coal gasification wastes, but to date very little evaluation has been carried out on these wastes. Praxis Engineers, Inc. prepared this report as part of an EPRI-sponsored study investigating the utilization potential of the gasification waste (slag) produced by the Cool Water facility, which uses integrated-gasification-combined-cycle (IGCC) technology. Basic chemical and physical properties of the slag were determined during this study. Its chemistry is quite similar to that of other coal combustion wastes, but its physical characteristics are considerably different due to the method of its formation, i.e., quenching of the molten mineral matter. On the basis of this work, sixteen potential applications were recommended for evaluation and show promise. The study also included evaluation of the utilization potential of the slag as a material for road construction and as a substitute for aggregate in cement concrete. However, before wider acceptance can be achieved larger-scale demonstration projects are required, both to overcome existing biases in favor of currently used materials, and to establish the economic competitiveness of the slag. 37 refs., 11 figs., 30 tabs.

22139 **Selectivity of hydrogen atom reactions.** Schroeder, K.; Bockrath, B.; Keldsen, G. (US DOE/PETC, Pittsburgh, PA). *American Chemical Society, Division of Petroleum Chemistry, General Papers, Preprints;* **31**: No. 3, 752(Sep 1986). (CONF-860911—).

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The chemistry of the hydrogen atom is of interest because of its role in hydrocracking reactions during coal liquefaction. By studying the competitive hydrocracking of various substrates under hydrogen pressure at 450°C in the presence of 1,3-dimethylnaphthalene as a reference, a number of factors that influence the extent of hydrocracking have been determined. In a series of substituted aromatic compounds, molecules containing phenyl rings hydrocrack less than molecules containing condensed aromatic rings. This is explained by the greater number of resonance structures in the σ-complex of the condensed ring molecules. The nature of the leaving group influences the extent of hydrocracking. Hydrocracking increased as the leaving group became more stable: R $\approx$ < phiCH/sub 2/ < phiO < phiS. Finally, steric acceleration appears to be important for highly substituted aromatics. The data is consistent with a mechanism in which hydrogen atom attacks the aro-

matic ring to form a σ-complex. This intermediate can then decay via loss of hydrogen atom to reform the starting material or by loss of the ipso substituent to form products.

0105 By-products

REFER ALSO TO CITATION(S) 22210

0106 Properties

REFER ALSO TO CITATION(S) 22084, 22085, 22096, 22106, 22168, 22176, 23046, 23056, 23059, 23094

22140 (CONF-8511136—, pp IV.88) **Microbial screening for lignite degradation.** Yen, T.F. (Univ. of Southern California, Los Angeles). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The main objective of this investigation is a study employing different biological methods for converting lignite into simpler compounds which can be subsequently processed to yield useful products. Present progress toward this goal is summarized as follows: (1) investigation on the chemical components in lignite which are sensitive to Polyporus versicolor attack; (2) study of the chemical approaches to reduce the lignite into suitable intermediates which are susceptible to microbial degradation; and (3) establishment of analytical and instrumental procedure for quantifying the degradation process. Progress in this research and the concept of using appropriate model systems and analogs to mimic lignite biodegradation will be discussed.

22141 (CONF-8511136—, pp VII.1) **Macromolecular structure and coal reactivity.** Larsen, J.W. (Lehigh Univ., Bethlehem, PA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The relative reactivity of coals in conversion to liquids will be a function of (1) the number of bonds which must be broken, (2) the intrinsic chemical reactivity of those bonds, and (3) mass transport rates. The macromolecular structure largely determines 1 and 3. Our current understanding of the macromolecular structure of coals is summarized. Quantitative macromolecular structures are presented for Illinois No. 6 coal and a lignite. The interactions between non-polar solvents and bituminous coals can be described quantitatively using regular solution theory. This approach also works for lignites, but only after the lignite's ability to form hydrogen bonds has been destroyed by hydroxyl derivatization. The interaction of polar solvents is described as due to hydrogen bonding to hydroxyl groups and a set of specific interactions not yet characterized. Using solvent swelling, the macromolecular structure of coal chars can be studied. This work is described as an example of how it can be used to gain insight into a chemical process. In a lignite, cross linking upon pyrolysis is concomitant with loss of CO and CO_2 and begins at a relatively low temperature. In a bituminous coal, cross link formation occurs much later. It does not begin until about 2/3 of the tar has been emitted. The implications of these observations are discussed as well as the application of these experimental probes to studies of liquefaction residues.

22142 (CONF-8511136—, pp VII.2-VII.7) **Ruthenium tetroxide oxidation of low-rank coals.** Olson, E.S.; Diehl, J.W.; Froehlich, M.L.; Miller, D.J. (Univ. of North Dakota Energy Research Center, Grand Forks). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract FC21-83FE60181.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The goal of these studies was to elucidate the structural features of coals which are believed to be important in conversion processes. Of special interest are the nature of the hydroaromatic groups and the bridging groups between aromatic moieties, because of their roles in thermal cleavage and depolymerization processes and the hydrogen shuttling which occurs during the depolymerization and stabilization of cleavage products. The first objective was the development of new methods for the isolation or solubilization of the aliphatic groups in the coal, which may then be related to these hydroaromatic systems and bridging groups. We have successfully used ruthenium tetroxide in a two phase solvent system with a phase transfer catalyst to selectively oxidize the aromatic groups. The oxidation of a North Dakota lignite with ruthenium tetroxide with the phase transfer catalyst proceeded rapidly at ambient temperature giving carbon dioxide and carboxylic acid products which were converted to methyl esters by diazomethane for qualitative analysis using GC and GC/MS. A very complex mixture of aliphatic mono and polycarboxylic acids and aromatic polycarboxylic acids was formed in the reaction. A comparison of three oxidation methods, the ruthenium tetroxide with phase transfer catalyst, the ruthenium tetroxide with acetonitrile and the trifluoroperacetic acid, was carried out on the same sample of Beulah lignite. There was no significant difference in the amounts of acid products between the two ruthenium tetroxide methods. A number of low-rank coals were oxidized for comparison purposes. Values for the amounts of six carboxylic acid products which were determined using the isotope dilution method are reported in Table 2. The amounts of the six acids in the oxidation products generally increase with coal rank or % C. 8 refs., 6 tabs.

22143 (CONF-8511136—, pp VII.8-VII.9) **The contrasting reduction, alkylation and reductive alkylation of low and high rank bituminous coal.** Stock, L.M.; Mallya, N.; Willis, R.S. (Univ. of Chicago, IL). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

A comparative study of the reduction, alkylation, and reductive alkylation of several different American coals has been carried out. The results for two coals - one a high volatile bituminous coal with 79% carbon (daf) from the Illinois Basin and the other a low volatile bituminous coal with 89% carbon (daf) from the Lower Kittanning Seam are discussed in this presentation. These results and other related observations provide new structural information enabling an analysis of the differences in structure of the two coals that lead to the large differences in the outcome of reduction, alkylation, and reductive alkylation reactions.

22144 (CONF-8511136—, pp VII.10-VII.53) **Chemical structure of low-rank coals.** Chung, K.E.; Goldberg, I.B. (Rockwell International, Thousand Oaks, CA). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Chemical structural characteristics of a Wyoming subbituminous coal and a Texas lignite were determined in terms of the distribution and arrangement of oxygen functional groups, aromatic clusters, linkages between the clusters and side chains on the clusters. The structural characteristics were used to construct molecular structural models specific to the coals examined. Also, the structural data were related to their hydroliquefaction yields such as potential products, their distribution and hydrogen consumption. The arrangements of aromatic clusters and functional groups were similar in both the coals. Two to four aromatic clusters of a similar size are linked to each other by alkyl C-C bonds, making a chain of aromatic clusters. Two or more of these chains are connected to each other by ester and ether groups. The size of aromatic clusters ranges from single ring to five-fused ring clusters. The two coals are different in the distributions of aromatic clusters and oxygen functional groups. The lignite contains fewer large aromatic clusters than the subbituminous coal, although they contain similar amounts of single ring and two-fused ring aromatic clusters. Hydroxyl and ether groups contain more of the oxygen in lignite than the ester and carbonyl groups. However, the ester and carbonyl groups contain more of the oxygen than hydroxyl and ether groups in the subbituminous coal. These structural data were used to predict the product distribution in the hydroliquefaction of each coal. The predicted distribution from the subbituminous coal agreed well with experimental values. The potential yield of distillable product from the lignite is 15% higher than that from the subbituminous coal. The amount of hydrogen to be consumed in cleaving alkyl linkages is 0.3% of feed in both the coals. 14 refs., 8 figs., 14 tabs.

22145 (CONF-8511136—, pp VII.54-VII.61) **Separation and characterization of hydroxyl aromatics in oils and asphaltenes from nondistillable, pyridine soluble coal-liquids.** Hurtubise, R.J.; Cooper, H.A.; Allen, T.W.; Silver, H.F. (Univ. of Wyoming, Laramie). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC22-83PC60015.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Hydroxyl aromatics are an important class of compounds in coal liquefaction processes. The separation and characterization of hydroxyl aromatics are particularly important for the development of coal liquefaction processes and for an understanding of coal liquefaction chemistry. It has been shown that oils and asphaltenes in high-boiling distillates and nondistillable, pyridine soluble coal-liquid samples produced in an SRC-I process consist of the same major compound classes: hydrocarbons, nitrogen compounds, and hydroxyl aromatics. However, as reported by Boduszynski et al. oils and asphaltenes differ in the concentrations of hydrocarbons, nitrogen compounds, and hydroxyl aromatics. In this work, hydroxyl aromatic fractions were isolated from oils and asphaltenes in nondistillable (>427°C) Wyodak and Kentucky pyridine soluble coal-liquid samples using procedures developed by Boduszynski et al. This was done to determine compositional differences between these coal-liquid samples and thus develop a better understanding of the coal liquefaction chemistry of the Wyodak and Kentucky coal samples. The fractions were further separated by normal-phase and reversed-phase liquid chromatography and then characterized by nuclear magnetic resonance, infrared, and field-ionization mass spectrometry. In addition, elemental analysis data were obtained on some of the fractions. In this presentation, emphasis is given to the analytical methodology and some of the compositional differences between the hydroxyl aromatic content of the Wyodak and Kentucky coal-liquid samples. 8 refs., 3 figs., 3 tabs.

22146 **(DOE/PC/70776—T10) Characterization of coal surfaces: Final report.** Fuerstenau, D.W.; Williams, M.C.; Herrera-Urbina, R. (California Univ., Berkeley (USA). Coll. of Engineering). Feb 1987. Contract FG22-84PC70776. 155p. NTIS, PC A08/MF A01; GPO Dep. File Number DE87005863.

This final technical report summarizes the accomplishments of an investigation on the characterization of the surface of coal that was supported by the Department of Energy under Grant No. FG22-84PC70776. The working period was from August 20, 1984, to November 20, 1986. Fundamental research work on the characterization of coal surfaces was directed toward delineation of how coal characteristics, surface properties, and oxidation affect the wetting behavior of coal in coal processing and utilization. A simple and rapid technique, called film flotation, was developed for the assessment of coal wettability. Since this method yields a distribution of wetting surface tensions, it seems to represent more realistically the wetting behavior of materials as heterogeneous as coal. The efficacy of this technique was affirmed by testing homogeneous particles of known wetting characteristics. Film flotation is found to be a useful, reproducible and very reliable method that is sensitive to surface energy changes due to surface heterogeneity and oxidation. The surface energy parameters obtained from the results of film flotation experiments serve as indexes to correlate the extent of coal oxidation. Since these parameters are highly dependent on the nature of the coal surface, they provide a means to ascertain the extent of coal oxidation and to relate wetting phenomena with surface-based processes for the preparation, conversion and utilization of coal. 90 refs., 61 figs., 14 tabs.

22147 **(DOE/PC/80517—T6) Improving the stability of coal slurries: Quarterly progress report for the period December 15, 1986-March 15, 1987.** Fogler, H.S. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 1987. Contract FG22-85PC80517. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006804.

The previous quarterly progress report focusing on the adsorption study of the polystyrene latex spheres with gum tragacanth (GT) indicated that the conformation of GT on the surface of latex spheres plays an important role in the stabilization. To prove this, photon correlation spectroscopy was undertaken, and the steric layer thickness was measured as a function of pH. The results showed that the thickness increases as pH decreases. It is possible that at lower pH the ionization of carboxylic groups is repressed so that GT molecules no longer repel each other and become extended. In addition, the experiments in which pH was lowered showed that the particles which flocculated in the GT solution at higher pH can be deflocculated owing to the increase in the steric layer thickness. 5 refs., 5 figs., 1 tab.

22148 **(DOE/PC/80522—T3) Metal arene complexes in coal structure determination: Quarterly report for the period December 1986-February 1987.** Woolsey, N.F. (North Dakota Univ., Grand Forks (USA). Dept. of Chemistry). Mar 1987. Contract FG22-85PC80522. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007399.

The development of arene metal (Cr, Fe) complex chemistry has continued this quarter. Peroxidation of the pentamethylbenzene tricarbonylchromium anion was definitely established not to give a phenolic product. The products of 1,3-dipolar cycloaddition of ozone and ethylazidoformate with a zwitterionic iron complex were identified and quantified. The product of a rhodium complex reaction with a useful ligand was established by x-ray crystal structure determination to not involve the desired carbon-carbon bond insertion reaction. Modification of the above procedures to facilitate the desired aryl-benzylic carbon detachment are under way.

22149 **(DOE/PC/90528—T1) Thermodynamics of coal liquid/solid systems: Quarterly progress report for the period of September 15, 1986 to December 15, 1986.** Holder, G.D. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Jan 1987. Contract FG22-86PC90528. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006805.

Equilibrium studies of binary and multicomponent aromatic systems are currently conducted in order to quantify the effect of coal solids on the vapor pressure of these systems. Both light and heavy model compounds with and without solids present are used. Actual coal liquids are also examined. The description of the apparatus used and some of the results obtained for systems investigated to date are described. 15 refs., 4 figs., 6 tabs.

22150 **(PB—87-148763/XAB) Electron transfer and radical-cation reactions of coal model compounds. Annual report, April 1985-March 1986.** Camaioni, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. 63p. NTIS, PC A04/MF A01.

The report describes the annual progress of a pr,ject directed towards determining the factors that govern the breaking of carbon-carbon bonds in coal-related aryl-alkyl molecules by radical cation pathways. Coal model compounds were oxidized by copper (II)-peroxydisulfate in water/acetonitrile/acetic acid media, and the reactions of the intermediate radical cations have been inferred from product analyses. Results for 9-methyl-, 9-hydroxymethyl-, 9-benzyl, 9-styrl-, 9,10-dimethyl-, and 2-ethylanthracene, and benzyl phenyl sulfides are presented and discussed. A new synthesis of lepidopterene, an oxidation product of methylanthracene, is described.

22151 **Selective methylation of hydroaromatic C-H sites in coal: The importance of fluorene-like structural units in bituminous coals.** Chambers, R.R. Jr.; Hagaman, E.W.; Woody, M.C. (Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN). *American Chemical Society, Division of Petroleum Chemistry, General Papers, Preprints;* **31**: No. 3, 803-805(Sep 1986). (CONF-860911—). Contract AC05-84OR21400.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

One of the primary objectives in the elucidation of coal structure is to identify the individual structural elements which are present and then to measure their relative abundance. The authors have used strong base chemistry as one means for achieving this goal. The approach has been to differentiate among the various structural units in coal by the difference in the acidity or pK(a) value of the benzylic C-H sites. The O-methylated coal was treated with the conjugate base of an appropriate hydrocarbon and the re-

action terminated by quenching with C-13, C-14 labeled methyl iodide. The C-14 label provides a convenient analytical means for monitoring the extent of alkylation and the reactive sites can be identified by CP/MAS C-13 NMR spectroscopy. The pK(a) of the hydrocarbon, B-H, was systematically varied over the range of 18.5 to 31 pK units. For O-methyl Illinois No. 6, the number of introduced methyl groups was found to be highly base dependent, increasing in the order 9-phenylfluorenyl < fluorenyl < trityl. This order of reactivity parallels the increase in the pK(a) of the hydrocarbons, which has been determined to be 18.5, 23 and 31 for 9-phenylfluorene, fluorene and triphenylmethane, respectively. These results can be interpreted in terms of a coal structure in which there are acidic sites which can be differentiated on the basis of their ionization constants.

22152 **Coal samples available from the premium coal sample program.** Vorres, K.S. (Chemistry Div., Building 211, Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL). *American Chemical Society, Division of Petroleum Chemistry, General Papers, Preprints;* **31**: No. 3, 761(Sep 1986). (CONF-860911—). Contract W-31-109-ENG-38.

From 192. American Chemical Society national meeting; Anaheim, CA, USA (7 Sep 1986).

The Premium Coal Sample Program at Argonne National Laboratory is in the midst of the collection of a suite of eight coal samples representing a range of chemical parameters, degrees of coalification, and sulfur contents. The procedures used in sample selection, collection, transport to the processing facility, processing, packaging, analysis, sample distribution and data storage are presented. The current status of the sample collection is indicated with an identification of the location of the different sample sources, coal ranks, and analytical information. Some description of the types of current research being done with these samples is also presented.

0108 Waste Management

REFER ALSO TO CITATION(S) 22137, 22165, 23119, 23429

22153 **(ANL/ECT-TM—6) User's guide for PARTIC II (Version II): A computer code for analyzing the performance of particulate-control devices.** Swietlik, C.E.; Farber, P.S. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31109-ENG-38. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006881.

This report documents a computer code, PARTIC II, developed to analyze the performance of particulate-control equipment on coal-fired boilers. The code is a modular one, with subroutines designed to design and model electrostatic precipitators, cyclones, and fabric-filter baghouses installed on boilers to control emissions. Additional modules perform economic analyses on the final system design. The PARTIC II code is written in Fortran for use on mainframe or personal computers.

22154 **(DOE/FC/10299—2261) Chemical and bioassay characterizations of sludge and wastewater from fixed bed UNDERC coal gasification: Final report.** Neufeld, R.D.; Sykora, J.L.; Keleti, G.; Moretti, C.; Cofano, J.; Mayernik, J.; Plautz, M. (Pittsburgh Univ., PA (USA)). 1 Jul 1986. Contract AC21-81FC10299. 367p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87005412.

The objective of this research is to evaluate the influence of eight preselected treatment trains for fixed bed coal gasification wastewater treatment on chemical and health effects of residual sludges, sludge leachates, partially treated wastewaters and cooling towers blowdowns. Independent variables were: (1) incorporation of solvent extraction, use of MIBK or DIPE as extractant, solvent/wastewater ratio; (2) incorporation of free with/without fixed ammonia stripping; (3) incorporation of biological activated sludge processing; (4) cooling towers evaporation at ten cycles of concentration. Residual sludges, cooling tower blowdowns, ashed blowdowns and evaporate organics were leached in accord with the ASTM-A (distilled/deionized water), EPA-"EP" (acetic acid), and a self designed technique (pH=2 using HNO_3 at a 20/1 liquid/solids ratio). Leachates were evaluated for heavy metal content, Daphnia magna toxicity, bioaccumulative potentials and AMES mutagenicity potentials.

22155 **(DOE/FE—0082) Summary report to Congress on emerging clean coal technologies capable of retrofitting, repowering, or modernizing existing facilities.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). 6 Mar 1987. 319p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87006604.

This Summary Report is the first of two transmittals to the Congress that were provided for in Pub. L. No. 99-500 with regard to the conduct of the informational solicitation for emerging clean coal technologies capable of retrofitting, repowering, or modernizing existing facilities. The Clean Coal Technology provision of that law stipulated that the Department of Energy "shall, no later than March 6, 1987, submit to Congress a summary report of statements of interest and informational proposals received and no later than one hundred and twenty days after the receipt of such statements and proposals submit to Congress a report that analyzes the information contained [therein]... and assesses the potential usefulness and commercial viability of each emerging clean coal technology for which a statement of interest or informational proposal has been received." Accordingly, the second transmittal to the Congress is due to be issued by May 12, 1987.

22156 **(DOE/PC/90505—T1) Mechanism of surface enrichment and adhesion of coal combustion particulates: First quarterly report.** Shadman, F.; Peterson, T.W.; Wendt, J.O.L.; Punjak, W.A. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Feb 1987. Contract FG22-86PC90505. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006348.

During the first three months of the project, the emphasis has been on the following areas: (1) design of the apparatus and development of the experimental techniques for the controlled adsorption of alkali on potential additives; and (2) development of techniques for the quantitative and qualitative characterization of alkali distribution in small additive particles using Scanning Auger Spectroscopy. The preliminary experiments of the adsorption of NaCl on bauxite show a very non-uniform distribution of alkali on the substrate. The chlorine appears to undergo some form of chemical interaction with alumina surface. An optimum set of electron beam parameters are found for which the alkali distribution is stable during Auger Spectroscopy and depth profiling by ion milling.

22157 **(DOE/PC/91101—T2) Sulfur dioxide removal from flue gases by supported copper and iron absorbents: Technical report No. 2, 11/16/86-2/15/87.** Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). 1987. Contract FG22-86PC91101. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007401.

In spite of some equipment malfunctions, progress has been made in the areas of Cu/Al_2O_3 sorbent preparation, characterization and evaluation. It is apparent that Cu/Al_2O_3 sorbents can readily be prepared from copper(II) acetate by using the extraction technique. The copper acetate is not present in these sorbents as a molecularly adsorbed species. It is concluded from the characterization studies conducted to date that the copper(II) ions are incorporated into the support with these ions occupying "octahedral" holes. The local environment of the copper(II) is expected to be close to D/sub 4h/ (Jahn-Teller distorted) than true O/sub h/ symmetry. EXAFS studies would be helpful in confirming this conclusion. The location of the acetate ion is uncertain; however, it is probably within the pores of the alumina support. Studies of the absorption of SO_2 from simulated flue gas have shown that the sorbents are effective under similar conditions to those used earlier for "standard" sorbents. Further investigation of factors affecting the sorption will be conducted in the future. These will include effect of support, wt % copper loading; and regeneration conditions. 2 refs., 3 figs., 1 tab.

22158 **(NYSERDA—87-3) Utilization potential of coal combustion by-products: Somerset Power Plant case study: Final report.** Baker, M. Jr. (New York State Energy Research and Development Authority, Albany (USA); Baker (Michael), Jr., of New York, Inc., Beaver, PA (USA)). Jan 1987. 541p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. File Number TI87900566.

This report provides analyses of the potential for the sale of ash and ash-derived products for twelve distinct applications in western New York State and the Toronto metropolitan area. Some unique features of this study include the distribution of a questionnaire directed at potential by-product purchasers, interviews with questionnaire respondents interested in the purchase of by-products and a telephone survey of electric utilities using ash marketing firms. The report includes two detailed economic analyses. The first is an analysis of a conventional by-products application scenario which entails bottom ash use for anti-skid material and fly ash use for cement replacement and mineral filler in pavements. The second is an analysis of a combination conventional/hi-tech scenario which entails separation of magnetic ash, segregation of quality pozzolan and manufacture of lightweight aggregate.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 22175, 22178

22159 **(PB—87-139424/XAB) Deposition of respirable coal dust in an airway. Report of Investigations/1986.** Courtney, W.G.; Cheng, L.; Divers, E.F. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 18p. (BM-RI—9041). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600131.

Because of the inherent safety problem associated with the deposition of airborne respirable dust onto the floor and other airway surfaces, the Bureau of Mines investigated the rate of reduction of airborne respirable dust in an airway due to deposition of the particles onto the surfaces of the airway. The effects of relative humidity and air velocity on the deposition rate were examined. It was found that the deposition rate was comparable in magnitude with the Stokes sedimentation rate and that it was independent of relative humidity. However, near the dust source the deposition rate depended significantly upon the air velocity, with such dependence decreasing with increasing distance from the dust source. These results suggest that deposition, though comparable with the Stokes sedimentation rate in magnitude, does not follow a simple Stokes-type process, and that the process of deposition remains to be explained.

22160 **(PB—87-139572/XAB) Using barriers to reduce dust exposure of longwall-face workers. Report of Investigations/1986.** Jankowski, R.A.; Babbitt, C.A. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 18p. (BM-RI—9037). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600080.

The Bureau of Mines has evaluated the use of passive barriers (dust shields) to help confine dust generated by longwall shearers to the face area. Laboratory studies focused first on selection of the optimum barrier design, which proved to be a simple, gobside barrier (made of conveyor belting), coupled with a headgate splitter arm, which was found necessary to prevent the dust cloud from entering the walkway at the headgate end of the shearer when cutting tail to head. It was found that the combination of gobside passive barriers plus the full shearer-clearer system was most effective, and surmised that this would be especially useful in thicker seams. However, underground testing revealed that the shearer-clearer system alone was 35 pct more effective in reducing dust contamination than when used with the gobside passive barriers, and far more effective than using passive barriers with a conventional water spray system.

22161 **Anaerobic bacterial dissolution of lead oxide.** Francis, A.J.; Dodge, C.J. (Brookhaven National Lab., Upton, NY). *Archives of Environmental Contamination and Toxicology;* **15**: No. 6, 611-616(Nov 1986).

An anaerobic bacterium (Clostridium sp.) isolated from coal waste solubilized a significant amount of lead oxide (PbO) and to a lesser extent $PbSO_4$, but not Pb^0, PbS, and galena. The rate of Pb dissolution during logarithmic growth of the bacteria in 40 ml of medium containing 3.32 μmoles of PbO was 0.042 μmoles/ml/hr. Dissolution of PbO by the bacteria was due to production of organic acids and lowering of the pH of the growth medium. The solubilized metal was bioavailable to the organism as evidenced by lead associated with cell biomass as well as immobilization by a polymer-like substance produced by the organism. These results suggest that under appropriate conditions microbial dissolution of PbO could be significant in the environment.

0110 Reserves And Exploration

22162 **(DOE/PC/91404—T3) Research needs and data acquisition to apply US technology to foreign coals: Quarterly report, January-March 1987.** (Viking Systems International, Pittsburgh, PA (USA)). 1987. Contract AC22-86PC91404. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007431.

Data on coal characteristics, resources and environmental aspects were gathered previously for India, Pakistan, Indonesia, Malaysia, Philippines, Thailand, Afghanistan and Colombia. The relevant data from the information obtained on these countries was retrieved, summarized and transmitted for inclusion in the PETC coal database. Coal deposits and their locations on national maps were also provided. The data on coal characteristics was stored in a computerized database. Data has now been gathered for the Republic of Korea (South Korea), Australia, and People's Republic of China (China). Data for 104 developing countries was obtained from the World Bank on energy inputs to electric utilities. This data was entered into a computerized database prepared at Viking. The data includes types of fuel input for electricity generation, power plant capacities, total electricity generation, system frequencies, etc. The user can extract information of his/her choice from the database in a spreadsheet format, which can then be interfaced with a graphics software package to obtain a pictorial representation of the data.

0120 Mining

REFER ALSO TO CITATION(S) 22083

22163 **(PB—87-139457/XAB) Underground-coal-mine lighting handbook. Part 1. Background. Information Circular/1986.** Lewis, W.H. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 49p. (BM-IC—9073). NTIS, PC A03/MF A01.

This Bureau of Mines report and its companion report (Information Circular 9074) were prepared as a complete reference on underground-coal-mine lighting. The report discusses the fundamentals of light and its interrelationship with the visual process. The purpose of the report is to insure an understanding of the numerous complex and interrelated factors that must be considered to design and implement a mine lighting system that will satisfy human needs for good vision and comfort. Topics include history, objectives, and technical considerations of coal-mine lighting; light physics; light and vision relationships; and disability and discomfort glare.

22164 **(PB—87-139465/XAB) Underground-coal-mine lighting handbook. Part 2. Application. Information Circular/1986.** Lewis, W.H. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 98p. (BM-IC—9074). NTIS, PC A05/MF A01.

The Bureau of Mines report and its companion report (Information Circular 9073) were prepared as a complete reference on underground-coal-mine lighting. The report discusses system design criteria and procedures, data, and specifications to aid in selection of suitable mine-lighting hardware, and guidelines for system installation and maintenance. Topics include light-measuring techniques and instruments, illumination regulations for underground-coal-mine environments and equipment, lamps and ballasts, available mine-

lighting hardware, design and evaluation of coal-mine illumination systems, and installation and maintenance of a mine lighting system.

22165 **(PB—87-139606/XAB) Testing materials for support-wall construction. Report of Investigations/1986.** Hay, K.E.; Johnston, J.L. (Bureau of Mines, Spokane, WA (USA). Spokane Research Center). 1986. 19p. (BM-RI—9038). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600123.

The Bureau of Mines collected coal and coal-waste aggregate material from two different mine sites to determine their strength characteristics for use in concrete. The concrete would be placed underground as support walls for ground control in adverse conditions or unique mining applications. A standard mix design was established for a wet mix using a water-to-cement (w/c) ratio of 1.0 to facilitate pumping into place. Later, material was collected from four more mine sites and used to make 2- by 2- by 2-ft test blocks with the same w/c ratio. A pullout cone device and borehole shear tester were used to determine the in-situ material strength of the test blocks. These techniques will provide a simple and quick way of determining support wall strength in an underground environment. Test results from the pullout cone device showed a good correlation of 0.98 to test cylinder compressive strengths of the same mix. Results ot the borehole shear tester were inconclusive.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 22784

22166 **(PB—87-134102/XAB) Transportation of lignite to the North Island. Technical and economic evaluation of options. Summary report.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). Aug 1986. 40p. NTIS, PC PC E03/MF E01.

The report gives a summary of the findings of a study into the technical and economic aspects of transporting lignites from the South Island deposits to points of use in the north of the North Island. Economic analysis of transport options based on a 1250-MWe demand show that significant improvement in drying/processing techniques would be required before such an option could be favored. The costs are presented as a transport cost per ton and as a delivered fuel cost in terms of costs per kilowatt-hour. It is concluded that transport of lignites to the North Island is highly unlikely to present an attractive means of utilizing the South Island deposits.

0140 Combustion

REFER ALSO TO CITATION(S) 22396, 22400, 22404, 22408, 22409, 22417, 22418, 23247

22167 **(BNL—39371) Evaluation of Glo-Klen additive in desulfurization: Final report.** Slegeir, W.; Butcher, T. (Brookhaven National Lab., Upton, NY (USA)). Oct 1986. Contract AC02-76CH00016. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006740.

The TGA has proven useful sorbent testing because it allows facile variable isolation and affords large rate differences. In another program employing the TGA and the boiler, we have found very large effects in the TGA become small, but nevertheless significant, effects in the boiler. It is our opinion that the synergism with barium titanate, though perhaps significant in the TGA, would probably be undiscernable in boiler tests. Under the range of conditions studied, Glo-Klen alone was found to have rather poor SO_2 capture ability. As a sorbent in coal-fired boilers, it would appear to be unable to compete with more conventional sorbents such as hydrated limes, in terms of rates, capacities, and perhaps cost. This project was concerned, in particular, with identifying cases where Glo-Klen may exhibit pronounced promotional effects with other sorbents to justify its use. Although a few cases of synergism have been observed, they have not yielded pronounced promotional effects. The synergism discussed in the Interim Report for Longview hydrated lime and Glo-Klen mixtures appears to be due primarily to mass transfer limitations. The very high activity of Longview hydrated lime leads to problems in delivering SO_2 sufficiently rapidly under our test conditions. Results of small scale boiler tests to date do not indicate a route to SO_2 reduction using Glo-Klen greater than the limits of experimental accuracy. This includes examination of Glo-Klen premixed with coal, Glo-Klen injected after the flame zone, and co-injection of Glo-Klen and sodium bicarbonate.

22168 **(DOE/FC/10614—2259) Fundamental combustion studies of hot water-dried low-rank coal slurries: Final report, March 1984-August 1986.** Germane, G.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). Sep 1986. Contract AC21-84FC10614. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001053.

This contract for fundamental combustion studies of low-rank coal slurries was initiated March 1, 1984 and ended August 31, 1986. Slurries which were studied were primarily those produced from hot water-dried lignite coal provided by the University of North Dakota Energy Research Center through the Grand Forks Project Office of the United States Department of Energy. Contract work included virgin coal and slurry characterization, slurry spray and atomization measurements, parametric combustion optimization tests, laboratory reactor mapping combustion firings, and model computations. Included in the detailed map are space-resolved measurements of combustion products and pollutants for lignite coal slurries, and comparison of results with computer model predictions and with data obtained in an earlier study of the combustion of bituminous coal-water slurry under similar conditions in the same reactor. 46 refs., 60 figs., 9 tabs.

22169 **(DOE/MC/21389—2051) Combustion and fuel bound contaminant control with a staged cyclone coal combustor for gas turbines: Topical report, July 1, 1985-March 31, 1986.** (Coal Tech Corp., Merion, PA (USA); USDOE Morgantown Energy Technology Center, WV). 22 Apr 1986. Contract AC21-84MC21389. 85p. (METC—86-TR-1). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007096.

The project objective is to evaluate operational parameters affecting contaminant control during staged, cyclone, coal combustion simulating direct coal firing into a gas turbine. A two stage, horizontal cyclone coal combustor has been operating at 5 and 7 MMBTu/hr thermal input. First stage carbon conversion was about 100% at stoichiometric air/fuel ratio, and it decreased with decreasing first stage air/fuel ratio. The bulk of the unburnt carbon particles were carried over into the second stage, where complete oxidation occurred as determined by gas analysis. With staged combustion, the measured NO/sub x/ measured at the second stage exit was reduced, for example, by 57% at a 65% stoichiometric air/fuel ratio. In addition, the benefits of staging for NO/sub x/ control were enhanced when second stage gas temperature was minimized, either through the use of high second stage dilution air, or by maximizing first stage carbon conversion, which reduced char particle carryover. Post test analysis of the slag indicates that most of the coal alkalies were retained in the slag. A high organic sulfur coal was used in these tests and over 90% of the coal sulfur was converted to SO_2 in the second stage, with no sorbent injection. With limestone injection into the second stage, nearly 100% SO_2 reduction was measured at economical Ca/S ratios. Second stage sorbent injection tests indicate that second stage temperature is a major factor in sulfur capture. With sorbent injection in the first stage, measured SO_2 in the first stage was reduced by up to 64% at about 70% stoichiometric ratio, at economical Ca/S ratios. The significance of these results are that they help identify combustor operating parameters, as well as their range of values for conditions applicable to gas turbine operation.

22170 **(DOE/MC/22077—2131) Effect of operating and design parameters on fluidized bed combustor in-bed tube metal wastage: Experimentation test plan: Quarterly report.** Blaylock, N.W.; Deffenbaugh, D.M. (Southwest Research Inst., San Antonio, TX (USA)). 13 Jun 1986. Contract AC21-85MC22077. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86016022.

The objective of this quarterly report is to summarize the work activities for the period from February 1, 1986 to April 30,

1986 for DOE Project No. DE-AC21-85MC22077 (SwRI Project 06-8863). The major effort during this period has been the development of an experimental test plan. The overall objective of this project is to study the phenomenon of in-bed tube metal wastage in a fluidized-bed coal combustor. This work includes a literature review, test plan development, design and fabrication of a test rig, and experimental program and data analysis. The literature review has been completed and reported on in last quarter's progress report. The experimental test plan is completed and documented in this report. The rig design will be initiated next quarter. 2 figs., 8 tabs.

22171 **(DOE/MC/22181—2258) Economic assessment of coal burning diesel locomotives: Topical report.** Hapeman, M.J.; Savkar, S.D. (General Electric Co., Erie, PA (USA). Transportation Systems Business Div.; General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Oct 1985. Contract AC21-85MC22181. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001052.

The coal burning steam locomotive was displaced many years ago by the diesel electric locomotive due to its several well-known advantages. However, the recent escalation of diesel fuel oil prices and the relatively inexpensive and plentiful coal supply provides an incentive to relook at a coal burning diesel electric locomotive. The success of the diesel-electric locomotive is really the result of two major technological changes: (1) the diesel engine, and (2) the electric drive transmission. The smooth, controlled application of power to the rails via electric motors, reduced the locomotive tractive weight by nearly 30%, and also reduced track maintenance by eliminating reciprocating vertical forces. More horsepower is also applied at low speeds to improve train acceleration. The diesel engine has been developed to produce nearly as much horsepower as the largest steam locomotives but with much less maintenance, higher reliability and more availability. The current cost of diesel fuel is now high enough to encourage a return to less-expensive, domestically-available coal fuel. However, it would be a step backward to lose the advantages of the diesel-electric locomotive. General Electric embarked upon a study to determine the best way to design and manufacture a coal-fired locomotive considering various prime movers, but all with electric drive. For a coal-fired diesel locomotive (CFDL) to be commercially viable, it must pass all three of the following criteria: be technically feasible; meet railroads' financial expectations; and offer an attractive return to the Locomotive manufacturer. These three criteria are reviewed based on results to date of General Electric's CFDL studies. The analysis assumes constant 1985 dollars and no significant changes in relative costs of diesel fuel and coal. 23 figs., 16 tabs.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 22097, 22124, 22671, 22681

22172 **(DOE/EIA—0035(86/12)) Monthly energy review, December 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 26 Mar 1987. 141p. NTIS, PC A07 - GPO. File Number DE87007382.

This article traces elements of key financial indicators in the US energy industry, based on a review of data for 188 energy companies for 1985 and 1986. The financial performance of these companies is reviewed as a whole and in four major sectors - petroleum (including natural gas production), natural gas transmission and distribution, coal, and electric utilities. Primary economic indicators increased modestly during 1986; real gross national product was up 2.5%. At the same time, energy prices declined in most sectors, falling sharply in the oil and gas sectors. Falling oil prices led to severe financial difficulties for the oil and gas production sector and petroleum-producing regions. Crude oil production fell by an estimated 3%, while crude oil imports increased by 32% compared with 1985. Overall, slow economic growth and rapidly falling energy prices reduced net income for the energy companies included in this review by 22%. Gains realized by the 95 coal and electric utility companies, which reported higher annual net income in 1986 than in 1985, were more than offset by the declines reported by the 93 petroleum and natural gas companies.

22173 **(PB—87-138327/XAB) Human resource management skills and coal mine productivity. Final report. Volume 1. Open File report.** Goodman, P.S.; Hersh, M.S.; Zak, C.A. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Graduate School of Industrial Administration). Mar 1985. 93p. NTIS, PC A05/MF A01.

Volume I of the report presents the first national survey of miners' attitudes and opinions about their work. The goal is to present attitudinal data that bear on coal production. Interviews were conducted in 26 mines with 2000 miners. High levels of cooperation were exhibited by management, union, and the employees. Data are presented about miners' attitudes about general aspects of their work such as pay, supervision, their jobs, etc. Another section of the report reviews opinions about specific aspects of work performance. Recommendations are presented.

22174 **(PB—87-138335/XAB) Human resource management skills and coal-mine productivity. Final report. Volume 2. Open File report.** Goodman, P.S.; Leyden, D.P. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Graduate School of Industrial Administration). Mar 1985. 79p. NTIS, PC A05/MF A01.

Volume II of the report explains reasons for the productivity differences in mining crews. The literature on group productivity is examined. Then a new approach to estimating productivity differences is proposed and estimated across seven different mines. The results indicate a fairly robust model in terms of explanatory power. Recommendations on how the model can be used as a managerial tool are presented.

0160 Health And Safety

REFER ALSO TO CITATION(S) 22160, 22163, 22164

22175 **(ANL/EES-TM—327) Emission factors for several toxic air pollutants from fluidized-bed combustion of coal.** Smith, A.E. (Argonne National Lab., IL (USA)). Mar 1986. Contract W-31109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007157.

Clean coal technologies such as fluidized-bed combustion have the potential to emit the same trace elements as conventional combustors. Since the US Environmental Protection Agency (EPA) is likely to promulgate National Emission Standards for Hazardous Air Pollutants for several trace elements, the feasibility of using fluidized-bed combustors to reduce sulfur dioxide emissions may depend in part on the relative amounts of trace elements emitted by fluidized-bed and conventional combustors. Emissions of trace elements from both atmospheric and pressurized fluidized-bed combustors were compared with those from conventional combustors by developing fluidized-bed emission factors from information available in the literature and comparing them with the emission factors for conventional combustors recommended in a literature search conducted for EPA. The comparisons are based on the mass of emission per unit of heat input for antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, vanadium, and zinc. When inaccuracies in the data were taken into account, the trace element emissions from atmospheric fluidized-bed combustion seem to be somewhat higher than those from a conventional utility boiler burning pulverized coal and somewhat lower than those from pressurized fluidized-bed combustion.

22176 (CONF-8511136—, pp II.55-II.73) **Chemical analysis and biological testing of catalytic-catalytic two-stage direct coal liquefaction process materials.** Wright, C.W.; Stewart, D.L.; Mahlum, D.D.; Chess, E.K. (Pacific Northwest Lab., Richland, WA). 1985. NTIS, PC A99/MF A01. File Number DE87006353. Contract AC06-76RL01830.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The purpose of this paper is to highlight the results of the chemical analysis and biological testing of the pressure filter liquid (PFL) and product distillate brand (PDB) materials from the 25-day demonstration run of the CTSL process. Where applicable, the data

from the analyses of the CTSL materials are compared to the results obtained from similar analyses of other two-stage coal liquefaction processes. The comparative processes include the integrated two-stage liquefaction (ITSL) and the nonintegrated two-stage liquefaction (NTSL) processes. Chemical analyses were performed on fractions isolated from the PFL and PDB materials by adsorption column chromatography. Chemical class fractions of aliphatic hydrocarbons (AH), polycyclic aromatic hydrocarbons (PAH), nitrogen-containing polycyclic aromatic compounds (NPAC), and hydroxy-substituted PAH (hydroxy-PAH) were produced using neutral alumina as an adsorbent. Due to the high concentration of hydrogenated and partially hydrogenated components present in these samples, the hydroaromatic compounds were isolated using picric-acid-coated alumina as an adsorbent. Selected chemical fractions isolated from the PFL and PDB materials were then analyzed by high-resolution gas chromatography, gas chromatography/mass spectrometry, and low voltage probe-inlet mass spectrometry. The biological activity of the CTSL materials was measured using two bioassays. The mutagenic response of all crude samples and chemical class fractions was measured using the histidine reversion microbial mutagenicity test with Salmonella typhimurium, TA98. Selected crudes were tested for tumorigenic potential using the initiation/promotion assay for tumorigenicity in mouse skin. 11 refs., 10 figs.

22177 (ORNL—6353, pp 149-154) **Induction and progression of neoplasia in the respiratory tract.** Marchok, A.C.; Martin, D.H.; Phipps, L.H.; Arnseth, L.M.; Cosma, G.; Fleming, G.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

This research focuses on the development of biological models for the purpose of identifying the underlying mechanisms involved in the initiation of cancer of the respiratory tract from exposure to hazardous agents in the environment that are potentially carcinogenic. Emphasis is placed on determining the changes in growth control mechanisms during tumor development. Studies were performed to determine the carcinogenesis of 7,13-dimethylbenzanthracene (DMBA), benzopyrene, a combination of benzopyrene and formaldehyde, and complex mixtures of fuel oils.

22178 **(PB—87-139598/XAB) Gas equilibrium in sealed coal mines. Report of Investigations/1986.** Litton, C.D. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 21p. (BM-RI—9031). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600122.

This Bureau of Mines report presents new concepts and procedures that have been derived for determining ambient equilibrium conditions in sealed coal mines. In particular, these concepts address problems usually encountered in determining the return of a mine to ambient-temperature levels after it has been sealed due to a fire. These concepts are applied to six sealed-mine fire incidents with good agreement.

22179 **Correlation of nitroaromatic compounds with the mutagenic activity of coal fly ash.** Harris, W.R.; Remsen, J.F.; Chess, E.K.; Later, D.W. (Univ. of California, Davis). *Journal of Toxicology and Environmental Health;* **20**: No. 1-2, 81-103(1987).

Stack-collected fly-ash particles from a commercial pulverized-coal power plant were extracted with 60/40 w/w benzene-methanol to remove as much of the organic fraction as possible. The extract was sequentially fractionated on a series of high-performance liquid chromatography columns, and the Salmonella bacterial mutagenicity assay using both normal and nitroreductase-deficient strains was used to localize the most mutagenic fractions. Selected fractions were analyzed by a variety of techniques, including gas chromatography with dual-flame ionization and thermionic nitrogen-phosphorus detectors, gas chromatography-mass spectrometry, direct-probe low-resolution or low-voltage mass spectrometry, and high-resolution mass spectrometry. Mutagenicity data indicated that nitroorganic compounds were the primary mutagens in all samples submitted for chemical analysis. A series of homologous alkylated nitrophenanthrenes appear to be important mutagens in one major fraction, while alkylated nitrofluorenones appear to be the dominant mutagens in a second major fraction. No nitro compounds were identified in a third major fraction. In addition to the nitro compounds, substantial amounts of fluorenones were also found, although these are not believed to contribute to the direct-acting mutagenic activity of the samples.

02 PETROLEUM

22180 **(PB—87-140125/XAB) Oil and Gas Field Code Master List (1986) and Oil and Gas Invalid Field Record List. Data file.** King, R. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Nov 1986. vp. NTISCP T02.

Supersedes PB—86-141520; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

EIA has developed a system of codification of the oil and gas fields throughout the United States, the Oil and Gas Field Master List. It is intended to provide a unique standard code for all oil and/or gas fields. The Master List is organized by State, with fields sorted alphabetically by name within each individual State. Fields located in the Federal Offshore area are listed with the adjacent State. The fields listed are geologic fields as defined by EIA. The six-digit field code is unique to the field name, regardless of whether one or several fields exist nationwide with that particular name. The Oil and Gas Field Code Master List is available on computer tape and is updated semi-annually. The Oil and Gas Invalid Field Record List are those records of field names and codes which were found to be technically incorrect or the fields nonexistent and therefore removed from the master list.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 23061

22181 **Noble gas composition of deep brines from the Palo Duro basin, Texas.** Zaikowski, A.; Kosanke, B.J. (Bendix Field Engineering Corp., Grand Junction, CO). *Geochimica et Cosmochimica Acta;* **51**: No. 1, 73-84(Jan 1987).

Deep groundwaters in sedimentary basins can be sufficiently old (> 10 m.y.) to have accumulated both radiogenic ^4He and $^{40}Ar^*$. Differences in the ratio of (U + Th)/K for aquifer lithologies lead to variations for $^4He/^{40}Ar^*$ in the groundwater. These variations can be used to resolve chronologically significant noble gas components. Application of a binary model to brine samples from the Palo Duro Basin, Texas yields (U, Th)-^4He residence times of 100 to 300 m.y. Concentrations of two non-radiogenic noble gases (^{20}Ne and ^{36}Ar) provide information on the salinities of the water that recharged these aquifers.

22182 **Well logging for physical properties.** Hearst, J.R.; Nelson, P.H. New York, NY; Mc Graw-Hill Book Co. (1985). 576p. Mc Graw-Hill Book Co., 1221 Avenue of the Americas, New York, NY 10020.

This book presents the fundamentals of well logging techniques for petroleum and natural gas deposits. Topics considered include the wellbore environment, logging practice; temperature, electrical and magnetic methods; nuclear radiation logging; acoustic logging; borehole gravimetry; ethology; porosity; saturation; permeability; fluid movement; fractures; elemental analysis; cement; directional surveying; dipmeter logging, and some other interesting applications.

22183 **Depositional setting and facies relations in Upper Permian red beds of the Palo Duro Basin, Texas Panhandle.** Nance, H.S. pp 67 of SEPM annual midyear meeting. Abstracts. Tulsa, OK; The Soc. of Econ. Paleontologists and Mineralogists (1985). (CONF-8508187—).

From Society of Economic Paleontologists and Mineralogists (SEPM) annual midyear meeting; Golden, CO, USA (11 Aug 1985).

Interbedded red sandstone, siltstone, mudstone, anhydrite, and halite comprise the Artesia Group (Guadalupian/Ochoan) of

the Palo Duro Basin. These deposits accumulated in a 10,000-mile/ sup 2/ low relief epicontinental basin that was characterized by regional aridity and episodic, nearly basinwide influx of marine-derived hypersaline waters. A variety of depositional environments developed in this basin including eolian dunes, interdune areas, eolian flats, intermittent fluvial, mud flats, and broad, shallow brine pans. Eolian dune deposits are represented by medium to high angle (15°-35°) crossbedded fine sandstone. Interdune areas accumulated rippled, bimodal, medium to very fine sandstone with frosted, spherical medium sand grains and pedogenic structures. Eolian flats are characterized by deposits of very fine sandstone with poorly defined ripples. Intermittent fluvial deposition resulted in very fine sandstones and siltstones with graded bedding, ripples with mud drapes, and intraclasts. Mud flat deposition produced mudstones with very disturbed ripples. Bedded halite and anhydrite were precipitated in brine pan environments. Landward margins of brine pans are characterized by deposits of sandstone and siltstone with displacive halite to chaotic halite-mudstone rock. Artesia Group facies occur in a characteristic vertical sequence that comprises, from base to top, bedded anhydrite, bedded halite, chaotic halite-mudstone, sandstone, and siltstone with displacive halite, very disturbed rippled mudstone, intermittent fluvial, and eolian clastics. The sharp contacts between these shallowing-upward sequences suggest that transgressions were rapid.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 22211

22184 (DOE/BC/10851—5) Dispersivity as an oil reservoir rock characteristic: Annual report for the period October 1, 1985-September 30, 1986. Menzie, D.E.; Dutta, S. (Oklahoma Univ., Norman (USA)). Mar 1987. Contract AC19-85BC10851. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001225.

The main objective of this research project is to establish dispersivity, α/sub d/, as an oil reservoir rock characteristic and to use this reservoir rock property to aid in enhancing crude oil recovery. A second objective is to compare the dispersion coefficient and the dispersivity of various reservoir rocks with other rock characteristics such as porosity, permeability, capillary pressure, and relative permeability. The dispersivity of a rock was identified as one of its physical property by measuring the mixing of two miscible fluids, one displacing the other in a porous medium. A core was 100% saturated with a liquid oil product (resident fluid) which was displaced by injecting a miscible liquid (displacing fluid). Samples of fluid produced from the outlet end of the core were analyzed for determining the percentage of the resident and the displacing fluid in the producing end. The extent of the spread of the concentration front (mixing) was measured from these samples by use of a refractometer after calibration with the specific fluids. The miscible liquids consisted of crude oil, naphtha and various mixtures of oil products. Dispersion coefficients and dispersivities for several Berea sandstone cores were determined and attempts were made to correlate with other standard oil reservoir rock characteristics. A direct relationship between dispersivity and total permeability was observed from the laboratory data. A correlation was also developed to correct for the difference in the viscosities of the two miscible fluids. A new method of calculating the relative permeability ratio of a miscible system was also proposed. Other correlations for dispersivity being attempted were Koval's heterogeneity factor (H-factor) and Peclet number. 11 refs., 12 figs., 6 tabs.

22185 (DOE/BC/10852—2) MEOR [microbial enhanced oil recovery] technical status and assessment of needs, 1986. King, J.W. (Hardin-Simmons Univ., Abilene, TX (USA). Fairleigh Dickinson Research Center). Mar 1987. Contract AC19-85BC10852. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001227.

This report summarizes the need for, the potential of, and the research still required for microbial enhanced oil recovery (MEOR). Enhanced oil recovery processes are those which recover oil unrecoverable by primary or secondary methods. To date, only chemical flooding, miscible flooding and thermal recovery have been considered as economical recovery techniques. Last year the DOE sponsored international MEOR workshop concluded that MEOR has merit as a cost-effective method for recovering residual oil. However, there has been no reliable and documented assessment of the technical and economic aspects of MEOR as compared to other EOR techniques. A review of the literature and the conclusions of the MEOR workshop have been summarized to determine the state-of-the-art of MEOR technology, its advantages and limitations and future. 16 refs., 7 figs.

22186 (DOE/MC/22042—5) Reservoir characterization for the CO_2 enhanced oil recovery process: Annual report. Orr, F.M. Jr.; Sageev, A. (Stanford Univ., CA (USA). Dept. of Petroleum Engineering). Mar 1987. Contract AC21-85MC22042. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001230.

This report summarizes progress in a research effort to quantify the effects of nonuniform flow on displacement performance in CO_2 floods. Results are reported in three areas: (1) effect of phase behavior in one-dimensional flow; (2) interaction of viscous instability and flow in heterogeneous porous media; and (3) detection and representation of reservoir heterogeneity. 94 refs., 83 figs., 8 tabs.

22187 (NIPER—226) Phase behavior and minimum miscibility pressures for nitrogen miscible displacement: Topical report. Llave, Feliciano M.; Chung, Ting-Horng. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1987. Contract FC22-83FE60149. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001229.

The phase behavior and minimum miscibility pressure (MMP) for nitrogen with light oils were studied. The phase behavior studies were performed on N_2 + hydrocarbon mixtures as well as N_2 + recombined oil systems at high pressures (above 4,000 psia). The synthetic oil system of $N_2 + C_1 + C_4 + C_{10}$ was studied to approximate the phase behavior of crude oils with nitrogen and to investigate the effect of the presence of methane on phase behavior and N_2 MMP values. The phase behavior data are used in a computer simulator to match the slim tube displacement behavior and to provide an estimate of the MMP. The N_2 + recombined oil studies provide the complex behavior of multicomponent systems. Adjustment of parameters to predict the phase envelope has been made in order to use these parameters in equations-of-state (EOS) for predictions at various reservoir conditions. This provides a cross-check of the conditions of miscibility achieved during the slim tube experiments. Experimental runs were performed in a slim tube apparatus to determine the MMP of stock-tank oils with nitrogen, recombined oils, and synthetic oils at pressures up to 10,000 psia and temperatures from 200 to 300 F. These experiments were performed using stock-tank oils with API gravities of 50.8° and 61.5°, recombined at different gas-oil ratios (GOR). The experimental results indicate the important contribution of light and intermediate components of crude oil in decreasing the MMP and show the variation in oil recovery as a function of temperature. Similar N_2 MMP tests were performed on two synthetic mixtures containing C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10}, and C_{13}. These studies will provide useful information for the implementation of the N_2 miscible displacement process. 26 refs., 28 figs., 7 tabs.

0204 Processing

REFER ALSO TO CITATION(S) 22113, 22114, 22115, 22116

22188 (AD-A—175231/0/XAB) Human factors in the management of Becon Construction Company's Heavy Oil Test Station Project. Final report. Maurer, D. (Army Military Personnel Center, Alexandria, VA (USA)). Nov 1986. 180p. NTIS, PC A09/MF A01.

In January 1986, the Becon Construction Company - an open-shop contractor based in Houston, Texas - mobilized a work force to a construction project location at the Belridge Oil Field, near Bakersfield, California. The construction craftsmen and helpers in Becon's work force were expected to improve their level of productivity as the work proceeded because of the knowledge and skills that they would acquire as a result of the repetitive nature of the work. As it was originally organized, the Becon HOTS project represented almost a pure laboratory environment in which to collect data concerning the learning effect on worker productivity as

well as to statistically isolate the impact on productivity of such external factors as weather, absenteeism, turnover, and especially work methods improvement techniques and pay incentives. From the outset of the HOTS project, the project manager had established an accurate system to quantitatively measure and compare the total manhours that each crew - civil, mechanical, electrical, and prefabrication – performed at individual HOTS construction locations. Additionally, it was initially assumed that the project manager would be relatively free to implement changes to the job site conditions involving incentive pay and work methods improvement. The subsequent effect of these changes on the productivity of separate work crews could then be evaluated in terms of measured manhours per crew per HOTS.

0205 Products And By-products

22189 **(AD-A—175660/0/XAB) Physics of fuel sprays. Volume 1. Experimental measurements. Annual report, September 1985-September 1986.** Dodge, L.G. (Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div.). 5 Dec 1986. 88p. (SWRI—8858/1). NTIS, PC A05/MF A01.

The objective of this program is to develop a better understanding of gas-turbine-type fuel sprays under realistic high-temperature and high-pressure evaporating conditions, and also at altitude-relight conditions. This includes developing computer models to predict spray behavior and evaporation rates and sophisticated diagnostics to verify these models. Progress includes: 1) Procedures for using the Aerometrics Phase/Doppler instrument and for processing the results were developed to the point that the instrument can be used to provide benchmark quality data for spray-model verification. Specifically, this instrument can be used to provide spatially-resolved drop-size distributions, drop-velocity distributions, and liquid volume-flux data. Problems in the liquid volume-flux measurements close to the atomizer (<25 mm) are still being investigated. It was necessary to compare the performance of the Aerometrics Phase/Doppler particle analyzer with the Malvern drop-sizing instrument. Because these instruments sample the spray in different ways, techniques were developed to correctly average the overall spray characteristics from measurements of different types of instruments. 2) A new, atmospheric-pressure spray facility was designed and constructed. This facility features a low-turbulence air-flow system and computer-controlled nozzle positioning for accurate measurements throughout the spray. 3) The effects of reduced air pressure on atomization were examined to gain better insight into altitude relight problems.

22190 **(AD-A—175749/1/XAB) Evaluation of FM-9 anti-misting kerosene variants. Final report, July 1982-August 1983.** Yavrouian, A.; Parikh, P.; Bernal, L.; Sarohia, V. (California Inst. of Tech., Pasadena (USA). Karman Lab. of Fluid Mechanics and Jet Propulsion). Sep 1986. 72p. (JPL-D—1599). NTIS, PC A04/MF A01.

The results of an experimental effort on evaluation of /FM-9 antimisting kerosene (AMK) variants developed by Imperial Chemical Industries (ICI) to improve the dissolution rate of mist suppression polymers in Jet A are described. Dissolution rate characteristics are important for the proposed AMK in-line blending associated with the aircraft fueling operation to minimize refueling turnaround time, enhance real-time quality control, and potentially simplify the blending equipment design requirements. The results obtained with these variants are compared with those obtained with batch blended FM-9 prepared by ICI. The key findings of this effort are: 1f) The dissolution rate of FM-9 variants (most batches) is better than FM-9. 2) The feasibility of single pass in-line blending for all additives under investigation was demonstrated. 3) Powder particle-size uniformity and slurry viscosity need optimization, otherwise the benefits of the faster dissolution rate cannot be realized. 4) Flow rate measured at 10 psi head pressure with AMK was approximately 40% lower than that of Jet A ambient (20 C) and low temperature (-35 C). Freshly in-line blended AMK fuels pumped as well as equilibrated batch-blended fuel.

22191 **(PB—87-132171/XAB) Legal nature of LPG (liquefied petroleum gas) regulation.** Liddell, G. (New Zealand Energy Research and Development Committee, Auckland). Aug 1986. 41p. (NZERDC—132). NTIS, PC PC E03/MF E01.

Errata sheet inserted.

The commercial exploitation of Liquefied Petroleum Gas (LPG) in New Zealand has occurred without a particular and comprehensive concern for any legal implications. The paper in Part I examines definitional questions, assesses in Part II the ability of courts and quasi-courts to evaluate risks associated with the product, examines in Part III the utility of common law remedies for injuries or associated with or arising from LPG, analyzes in Part IV the statutory regulation of LPG, concentrating particularly on the Dangerous Goods (Class 2 - Gases) Regulations 1980, discusses in Part V recent planning case-law concerning LPG development, and concludes that some reform is necessary to produce a more-coherent and precise regulatory regime that takes into account both the needs of developers and those affected by the development of LPG.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 22172, 22188, 22681, 22685

22192 **(BNL—39180) Validation of the Outer Continental Shelf oil and gas supply model.** Kroon, M.W. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006907.

The Outer Continental Shelf (OCS) model is designed to evaluate supply responses to changes in energy market variations, including changes to such institutional factors as lease scheduling and bidding practices. It is based on a representation of the steps followed by firms in exploring and developing oil or gas prospects in the offshore; geological and geophysical exploration, leasing, exploratory drilling, field development and production.

22193 **(BNL—39350) Documentation: The automated ORAD [Oil Refinery and Distribution Model] to RYMs [Refinery Yield Model] linked system.** Sanders, R.P.; Kydes, A.S. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006744.

The Refinery Evaluation Modeling System (REMS) is an analytic tool used by the Energy Information Administration (EIA) to provide insight into the domestic operations of United States refineries. REMS can be used to determine the potential impacts of changes in demands for petroleum products, crude and feedstock qualities, refinery processing capacities, foreign and domestic crude availabilities, transportation modes and costs, and government regulations. REMS is a set of linear programming models that solve for a partial equilibrium in the US refinery market by equating supply and demand while maximizing profits for US refiners. REMS consists of two models: the Refinery Yield Model (RYM), and the Oil Refinery and Distribution Model (ORAD). RYMs consists of nine separate regional models that represent the contiguous US refinery system. These nine regions are aggregates of the 13 Bureau of Mines (BOM) refinery districts. ORAD integrates the results from the individual RYMs into a transportation network which represents the US refinery market. ORAD uses the extreme point refinery representation from RYMs to solve for the optimal product prices in ORAD.

22194 **(DOE/EIA—0321/1(84)) Residential Energy Consumption Survey: Consumption and expenditures, April 1984 through March 1985: Part 1, National data.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 4 Mar 1987. 189p. NTIS, PC A09/MF A01 - GPO; 1; GPO Dep. File Number DE87006842.

This report presents data collected in the 1984 Residential Energy Consumption Survey (RECS) conducted by the Energy Information Administration (EIA). The 1984 RECS was the sixth na-

tional survey of US households and their energy suppliers. The purpose of these surveys is to provide baseline information on how households use energy. Households in all types of housing units - single family homes (including townhouses), apartments, and mobile homes - were chosen to participate. Data from the surveys are available to the public in published reports such as this one and on public-use data tapes. The report presents data on the US consumption and expenditures for residential use of these "major fuels" - natural gas, electricity, fuel oil, kerosene, and liquefied petroleum gas (LPG) - from April 1984 through March 1985. These data are presented in tables in the Detailed Statistics section of this report. Except for kerosene and wood fuel, the consumption and expenditures data are based on actual household bills obtained, with the permission of the household, from the companies supplying energy to the household. Purchases of kerosene are based on respondent reports because records of "cash and carry" purchases of kerosene for individual households are usually unavailable. Data on the consumption of wood fuel (Table 27) covers the 12-month period ending November 1984 and are based on respondent recall of the amount of wood burned during the 12-month period. Both the kerosene and wood consumption data are subject to memory errors and other reporting errors. This report does not cover household use of motor fuel, which is reported separately.

22195 **(DOE/EIA—0380(86/12)) Petroleum marketing monthly, December 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 3 Mar 1987. 156p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. File Number DE87006839.

The Petroleum Marketing Monthly is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0208 Waste Management

REFER ALSO TO CITATION(S) 23119

22196 **(NYSERDA—87-2) Controlling the effects of deteriorating fuel oil quality through oil-water emulsions: Final report.** (Long Island Lighting Co., Hicksville, NY (USA); New York State Energy Research and Development Authority, Albany (USA)). Jan 1987. 63p. New York State Energy, Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. File Number TI87900565.

A greater yield of lighter fractions from a barrel of crude oil has resulted in an end product fuel oil with an increased concentration of larger molecular hydrocarbons (asphaltenes), increased metallic compounds (either natural or added), siliceous materials and tramp catalytic compounds. The combined effect of all of these materials results in "deteriorating fuel oil quality." Both the initial and final phase of the project have been completed showing a marked reduction in particulate emissions and rate of opacity increase.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 22437

22197 **(PB—87-136966/XAB) Review of new source performance standards for petroleum-refinery fuel gas. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div.). Oct 1986. 92p. (EPA—450/3-86/011). NTIS, PC A05/MF A01.

As required by Section 111(b) of the Clean Air Act, as amended, a four-year review of the new source performance standards for petroleum refineries (40 CFR Subpart J) was conducted. The review was limited to the sulfur dioxide standard as applied to refinery fuel gas. The report presents a summary of the current standard, the status of current applicable control technology, and the ability of plants to meet the standard. No revision to the standard is recommended; however, EPA should investigate an alternative method of continuously measuring the sulfur concentration of refinery fuel gas.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 22191

0230 Properties

REFER ALSO TO CITATION(S) 22999

22198 (DOE/METC—87/6073, pp 169-203) **Cerro Negro heavy petroleum - separation and analysis of acid, base, saturate, and aromatic fractions.** Brown, J.C.; Green, J.B.; Grigsby, R.D.; Grizzle, P.L.; Hirsch, D.E.; Hazos, M.; Reynolds, J.W.; Sanchez, V.; Scheppele, S.E.; Shay, J.Y.; Sturm, G.P. Jr. (Univ. of Wisconsin, Madison). Oct 1986. NTIS, PC A23/MF A01. File Number DE87001002. (CONF-860717—). Contract FC22-83FE60149.

From 2. tar sand symposium; Jackson, WY, USA (8 Jul 1986).

Cerro Negro 200-425, 425-550, and 550-700 C distillates and > 700 C residue were separated into acid, base, and neutral concentrates using an improved nonaqueous ion exchange liquid chromatographic procedure. Neutral concentrates were further separated into neutral-aromatic and saturated hydrocarbon fractions. A dual column, normal phase high performance liquid chromatographic method was developed for the saturate-aromatic separation. Both separation procedures are described in detail along with results from their application to Cerro Negro heavy oil. Mass and elemental balances are given for separations of all distillates and the residue. In addition, fractions from the 200-425 C and 425-550 C distillates were analyzed by mass spectrometry. The objectives of the report are to describe the composition of Cerro Negro to the extent possible with the above separations and analytical data, and to demonstrate the applicability of this approach for analysis of fuels including heavy oils and bitumens. In addition, the need for further separations to obtain more definitive analysis of complex materials is demonstrated. Cerro Negro crude was found to contain 18.2 weight percent acids, 17.6 weight percent bases, 46.9 weight percent neutral aromatic, and 14.7 weight percent saturated hydrocarbons. Saturate fractions contained predominantly cycloparaffins, neutral-aromatics were largely comprised of aromatic hydrocarbons and sulfur compounds, bases were largely nitrogen-containing compounds, and acids were mostly oxygen-containing compounds and nitrogen compounds of pyrrolic-type. 36 references, 8 figures, 10 tables.

0240 Storage

REFER ALSO TO CITATION(S) 22213

22199 **(DOE/FE—0084) Strategic Petrolem Reserve: Annual/quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). Feb 1987. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007758.

In August 1986 the President reaffirmed the Administration's strong support for development of a 750 million-barrel Strategic Petroleum Reserve and committed the Administration to filling the Reserve throughout fiscal year 1987. During 1986, a number of bills related to the Strategic Petroleum Reserve were enacted. As of December 31, 1986, the Strategic Petroleum Reserve crude oil inventory was 511.6 million barrels of crude oil, an increase of 18.3 million barrels over the 1985 year end inventory of 493.3 million barrels. The Strategic Petroleum Reserve was filled at an average fill rate of 51,430 barrels per day during 1986. During the calendar year 1986, the Strategic Petroleum Reserve increased its crude oil storage capability from 509.4 million barrels to 550.7 million bar-

rels, adding approximately 27.4 million barrels of new storage capacity at the Bryan Mound storage site and 13.9 million barrels at the West Hackberry storage site. As required by the Energy Policy and Conservation Amendments Act of 1985, enacted July 2, 1985, the Department of Energy conducted a test sale of Strategic Petroleum Reserve crude oil between November 18, 1985 and January 31, 1986, to test the Strategic Petroleum Reserve's drawdown and distribution capabilities. In addition to the test sale, three subsequent tests of the Strategic Petroleum Reserve's physical drawdown capabilities were conducted. Substantial progress was made in distribution enhancement program during 1986, with the construction of a 46-mile oil distribution pipeline from Bryan Mound to the ARCO common carrier pipeline system at Texas City, TX. 9 figs., 9 tabs.

22200 **(PB—87-130480/XAB) Development of 1.5Ni-CLC steel for LPG storage tanks.** Imagumbai, M.; Aikawa, N.; Horiya, T.; Chijiiwa, R.; Nagumo, M. (Nippon Steel Corp., Tokyo). 1986. 14p. NTIS, PC PC E05/MF E01.

Included in Nippon Steel Technical Report, No. 28, 55-68(Jan 1986).

A new steel (1.5Ni-CLC steel) has been developed to meet the recent demand which requires LPG cylindrical storage tanks with extremely high safety against brittle fracture. The new steel exhibits excellent fracture toughness both in the base metal and in the weldments regarding resitivity against brittle crack propagation as well as initiation. The new steel is designed to obtain improved fracture toughness not only of plate itself but of weld joints, taking full advantage of the latest refining technology in steelmaking and accelerated cooling process on the base of a chemical composition with a maximum addition of 1.5% nickel.

22201 **(SAND—86-7181) Additional geotechnical studies: Strategic Petroleum Reserve (SPR), Weeks Island, Louisiana.** (Acres International Corp., Buffalo, NY (USA)). Dec 1986. Contract AC04-76DP00789. 251p. NTIS, PC A12. File Number DE87007360.

Previous studies undertaken at the Weeks Island SPR site placed high risk potential on shaft leakage that could lead to shaft failure and ultimately to loss of the crude oil containment. As a result, a geotechnical investigation was undertaken by Sandia National Laboratories (Sandia) and Acres International Corporation (Acres) to define the stratigraphy and hydrologic conditions around the shafts in an attempt to quantify the actual risk potential and define various failure scenarios. In addition, various alternative remedial actions, which could be employed to either eliminate or minimize these risks, were addressed. The investigation program consisted of the drilling of two test borings in proximity to the Service and Production Shafts. These borings confirmed that the stratigraphy overlying the dome in this area consists principally of unconsolidated, well sorted, sandy gravel and sand with permeabilities in the range of 10^{-2} to 10^{-4} cm/sec. The upper zone of salt was found to be highly friable and fractured with high permeability. The ground water regime over the dome consists of a single aquifer whose water level corresponds with sea level. The salinity of the ground water increases with depth, becoming fully saturated at the top of the salt. Normal recharge of the aquifer is from downward migration of precipitation with radial drainage to the various water courses surrounding the dome. Based on the field and laboratory testing, it is concluded that an uncontrolled leak developing in the shafts could result in rapid flooding of the mine workings, with water flowing from the water courses surrounding the dome. The oil withdrawal system would be inoperable. Subsequent erosion/solutioning of the salt around the oil containment bulkheads could lead to the ultimate loss of oil. 28 figs.

0250 Combustion

REFER ALSO TO CITATION(S) 22167

03 NATURAL GAS

REFER ALSO TO CITATION(S) 22180

0301 Reserves

REFER ALSO TO CITATION(S) 22204

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 22181, 22182, 22183, 22387

22202 **(DOE/MC/21181—1950-Vol.6) Geological evolution and analysis of confirmed or suspected gas hydrate localities: Volume 6, Basin analysis, formation and stability of gas hydrates in the Panama Basin.** Krason, J.; Ciesnik, M. (Geoexplorers International, Inc., Denver, CO (USA)). Mar 1986. Contract AC21-84MC21181. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86006636.

This report presents a geological description of the Panama Basin, including regional and local structural settings, geomorphology, geological history, stratigraphy, and physical properties. It provides the necessary regional and geological background for more in-depth research of the area. Detailed discussion of bottom simulating acoustic reflectors, sediment acoustic properties, distribution of hydrates within the sediments, and the relation of hydrate distribution to other features such as salt diapirism are also included. The formation and stabilization of gas hydrates in sediments are considered in terms of phase relations, nucleation, and crystallization constraints, gas solubility, pore fluid chemistry, inorganic diagenesis, and sediment organic content. Together with a depositional analysis of the area, this report is a better understanding of the thermal evolution of the locality. It should lead to an assessment of the potential for both biogenic and thermogenic hydrocarbon generation. 63 refs., 38 figs., 7 tabs.

22203 **(DOE/METC—87/0246) Gas hydrates: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Jan 1987. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001027.

In 1983, the US Department of Energy (DOE) assumed the responsibility for expanding the knowledge base and for developing methods to recover gas from hydrates. These are ice-like mixtures of gas and water where gas molecules are trapped within a framework of water molecules. This research is part of the Unconventional Gas Recovery (UGR) program, a multidisciplinary effort that focuses on developing the technology to produce natural gas from resources that have been classified as unconventional because of their unique geologies and production mechanisms. Current work on gas hydrates emphasizes geological studies; characterization of the resource; and generic research, including modeling of reservoir conditions, production concepts, and predictive strategies for stimulated wells. Complementing this work is research on in situ detection of hydrates and field tests to verify extraction methods. Thus, current research will provide a comprehensive technology base from which estimates of reserve potential can be made, and from which industry can develop recovery strategies. 7 refs., 3 figs., 6 tabs.

22204 **(DOE/METC—87/0248) Morgantown Energy Technology Center technology status report: Eastern gas shales.** (USDOE Morgantown Energy Technology Center, WV). Jan 1987. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001029.

Eastern gas shales research has been successful in characterizing the geology, geochemistry, and resource magnitude of the Appalachian Basin, and in defining the gas-producing mechanism and drainage pattern in an established area of production near the

middle of the basin. In addition, an offset well test (two wells offset to a producing well) established reservoir flow behavior and identified the potential for infill drilling of existing shale gas fields. Infill drilling may be a cost-effective strategy to exploit gas resources within known producing areas. In areas of established production (eastern Kentucky, southern and western West Virginia, and southern Ohio), the 3 trillion cubic feet (Tcf) produced to date could be increased thirtyfold without further exploration. Currently, research focuses on fundamental reservoir properties from wells of opportunity, and on the installation of a second offset well test site for understanding reservoir flow behavior. This research entails gathering reservoir property data from 10 sites that have favorable geology and geochemistry in areas of nonestablished production. This information will quantify the magnitude of matrix and fracture porosity and permeability and reservoir anisotropy, and will improve the ability to quantify technically recoverable resources for these areas of unknown potential. Also under study are methods to increase recovery efficiency from a directionally drilled well in an area of historical production, wherein less than 10% of the available gas-in-place is typically produced by stimulated vertical wells. 6 refs., 4 figs., 2 tabs.

22205 **(SAND—87-0040) Reservoir sedimentology of Mesaverde rocks at the Multiwell Experiment site and east central Piceance Creek Basin.** Lorenz, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007349.

Three types of low-permeability sandstone reservoirs are encountered in Upper Cretaceous rocks of the Mesaverde Formation in the US Department of Energy's Multiwell Experiment (MWX) wells in the east-central Piceance Creek Basin, northwestern Colorado. Reservoir characteristics of each type of sandstone are a function of the environment in which it was deposited. Sandstone reservoirs deposited in a fluvial environment are composed of stacked point bar deposits, creating irregular, composite sand bodies. Underlying this, distributary channel reservoirs were deposited on a delta plain as elongate lenticular bodies. They are associated with mudstones on the upper delta plain (coastal) and with mudstones and coals on the lower delta plain (paludal). Below these deposits is a series of blanket sandstone reservoirs deposited as regressive, wave-dominated deltas and shorelines, interbedded with nonmarine coals and marine shales. Best estimates of reservoir morphology, dimensions, trends, and internal characteristics can be made on the basis of sedimentological models and characteristics observed in core and in outcrops near the well site. 21 refs., 17 figs.

0303 Drilling, Production, And Processing

22206 **(LBL—22664) Development of a process for simultaneous desulfurization, drying, and recovery of natural gas liquids from natural gas streams.** Sciamanna, S.F.; Lynn, S. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 226p. NTIS, PC A11. File Number DE87007177.

In general, raw natural gas is a mixture of hydrocarbon gases that may also contain sulfur compounds, water and a small amount of inert gases. Conventional natural gas processing schemes are based on the sequential removal of sulfur compounds, water and hydrocarbon liquids. Each processing step requires a different process. The processing scheme proposed here removes all three in a single absorption step and is an integrated arrangement based on the University of California, Berkeley Sulfur Recovery Process (UCBSRP) technology. This processing scheme promises both reduced capital and operating costs. High purity sulfur product and natural gas liquids are produced and all exit streams contain less than 1 ppM of either hydrogen sulfide or sulfur dioxide. The UCBSRP technology is based on absorption of hydrogen sulfide and sulfur dioxide by a polar organic solvent. Certain classes of polyglycol ethers are suitable solvents for hydrogen sulfide, sulfur dioxide and light hydrocarbon gases. These solvents are also miscible with water. Hydrogen sulfide reacts with sulfur dioxide (generated by burning sulfur) in the liquid phase to form elemental sulfur and water. Sulfur is partially miscible in the solvent. Information on the solubility of hydrocarbon and acid gases is required for these organic solvents. Furthermore, knowing the solubility of elemental sulfur in these solvents is also necessary. The experimental portion of this work is concerned with the measurement of these solubilities as a function of temperature, solvent composition and water content. Solubility data were collected for hydrogen sulfide, sulfur dioxide, carbon dioxide, propane, and butane in a variety of mono- and diethers of polyethylene glycol. Solubility data for sulfur in these solvents were also collected. Correlations were developed for both gas and sulfur solubilities. 18 refs., 25 figs., 21 tabs.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 22172, 22212, 22681

22207 **(DOE/EIA—0130(87/01)) Natural Gas Monthly, January 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 24 Mar 1987. 159p. NTIS MF A01 - GPO; 2; GPO Dep. File Number DE87007574.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the US are provided for each year from 1980 through 1985 with monthly data for the most recent 3 years. Some data are also given by state or city, some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are: "Underground Natural Gas Storage in the United States"; "US Imports and Exports of Natural Gas"; and "Main Line Sales of Natural Gas to Industrial Users". 6 figs., 34 tabs.

22208 **The evolving natural gas market.** Naeve, M. (Federal Energy Regulatory Commission, Washington, DC). pp 141-143 of Proceedings of the sixty-fifth annual convention of the Gas Processors' Association. Tulsa, OK; Gas Processors Association (1986). (CONF-860327—).

From 65. annual convention of the Gas Processors Association; San Antonio, TX, USA (10 Mar 1986).

Natural gas markets are, indeed, in a state of evolution. Changes are occurring at such a rate that many participants in the market consider themselves to be in a state of revolution, rather than evolution. This paper examines on the changes which stem from the decontrol of wellhead. Prior to 1977 interstate gas prices were so low that gas faced no real competition from alternative fuels. Demand always exceeded supply and soon the inevitable happened - widespread shortages erupted. The partial decontrol of producer sales increased gas into a vigorous competition for market share with alternative fuels. Unfortunately, the natural gas industry simply was not prepared for such competition. The producers, transporters and buyers of gas had to develop a new understanding of the rewards and the risks which accompany price competition.

22209 **Impacts of natural gas pricing on Illinois and the midwest.** Beaver, F.M. (Div. of Energy and Environmental Affairs, Illinois Dept. of Energy and Natural Resources). pp 121-125 of Natural gas deregulation: Its impact on Illinois and the Midwest. Chicago, IL; University of Chicago Press (1983). (CONF-8310123—).

From 11. annual Illinois energy conference - natural gas deregulation; Chicago, IL, USA (13 Oct 1983).

It is important to compare and contrast current policy, the Natural Gas Policy Act, with the relative impacts of decontrol, recontrol and common carriage. The energy economists at the Department of Energy and Natural Resources have modeled the impacts of these three options relative to what is expected to unfold under NGPA. In this analysis the authors were concerned with impacts on jobs, wages and real disposable income. The NGPA is the base case in the analysis since it is the current pricing structure and will continue, unless Congress acts to change it.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 22437

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 22204

22210 **(PB—87-139416/XAB) Economic evaluation of horizontal borehole drilling for methane drainage from coalbeds. Information Circular/1986.** Baker, E.C.; Grau, R.H.; Finfinger, G.L. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 26p. (BM-IC—9080). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600068.

The potential profitability of a horizontal borehole drilling program for recovering methane gas in an Alabama coalbed for 6 yr in advance of mining is estimated in the Bureau of Mines report. A cash flow analysis based on estimated capital investments, annual operating costs, and the selling price of methane gas was used to determine the net income and net cash flow for each year of operation. Subsequently, the annual net cash flows were capitalized to determine the discounted cash flow rate of return. Findings indicate that a 25.08-percent interest rate of return on investment could be realized from the sale of methane gas in excess of 3 billion cubic feet during the years 1985 through 1990 at a minesite price of $2.25/per thousand cubic feet.

22211 **(UCID—20995) Extended analysis of constant-height hydraulic fractures for the estimation of in-situ crack-opening modulus from bottomhole pressure records.** Wijesinghe, A.M. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006887.

Hydraulic fractures created in oil and gas bearing rock formations can be made to propagate for a limited time at approximately constant height if favorable stress, deformation modulus or fracture toughness barriers to height growth exist and if the fracture design is suitably optimized to exploit these favorable conditions and reduce height growth. In this report, a unified theoretical formulation for the Perkins-Kern-Nordgren (PKN) and Christianovitch-Geertsma-De Klerk-Daneshy (CGDD) constant height fracture models is first presented. For a fracture fluid injection rate that varies as an arbitrary power of time, growth laws for fracturing fluid pressure, fracture width, and flow rate are rigorously derived for PKN and CGDD types of fractures. These similarity solutions account for non-Newtonian power-law fluid flow, transient fluid storage and generalized power-law fluid leak-off to the rock formation. They include and extend the results currently available in the literature for PKN and CGDD fractures. The results for PKN and CGDD fractures are then generalized to obtain an approximate hybrid CGDD-PKN fracture model that can be applied to constant height fractures of arbitrary length/height aspect ratio and arbitrary cross-sectional shape. Characteristic times for fracture extension are identified and estimates are given for the transition times when the fracture evolves from a CGDD-type fracture at small aspect ratio to a PKN-type fracture at large aspect ratio. These results are useful for interpreting fracturing data and for designing fractures for crack-opening modulus measurements.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 22209

0320 Transport, Pipelines, And Handling

22212 **(PB—87-148797/XAB) Advanced systems development - interior piping materials/configuration. Topical report, design concepts, March 1985-October 1986.** Kashalikar, U.K.; Sykes, R.C. (Foster-Miller, Inc., Waltham, MA (USA)). Oct 1986. 386p. NTIS, PC A17/MF A01.

See also topical report dated Jul 86, PB—87-102141.

New material and component design concepts were developed for interior distribution of natural gas. The objective was to create safe and reliable piping systems with total installed costs that are competitive with electrical wiring serving the same types of appliances. A set of 13 candidate concepts were evaluated with respect to the previously defined performance criteria, applications diversity, technical feasibility, component costs, and installation criteria. Five candidate concepts emerged as having promise for further development. These are a plastic coated aluminum conduit with new mechanical joint fittings, polymer lined copper tubing with polymer coated flare type fittings, modified copper alloy components for improved corrosion resistance to sulfur compounds, a modified version of the corrugated stainless steel conduit developed by Japanese utilities, and a damage sensing version of corrugated plastic conduit.

0330 Properties

REFER ALSO TO CITATION(S) 22203

0350 Storage

22213 **(PB—87-130449/XAB) Low-temperature service facilities and recent status of their materials and welding.** Saiga, Y.; Minoda, K.; Kimura, T.; Kumakura, Y.; Fukagawa, M. (Nippon Steel Corp., Tokyo). 1986. 23p. NTIS, PC PC E05/MF E01.

Included in Nippon Steel Technical Report, No. 28, 1-22(Jan 1986).

Low-temperature service facilities are numerous and various. Typical ones are low-temperature service tanks for LPG, LNG, etc., which play an important role in storage and transportation of liquefied gas, off-shore structures for oil drilling under severe climatic conditions such as those encountered in the North Sea and the Artic Ocean, and cryogenic service machinery and containers for liquefied helium and liquefied hydrogen which are indispensable for such high-technology fields as superconducting magnets and rockets. The paper describes the specifications and design requirements of these facilities, materials and welding methods, and relevant problems.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 22214

0404 Oil Production, Recovery, And Refining

22214 **(DOE/FE/60177—2295) Postburn lithology and mineralogy at Rio Blanco Oil Shale Company's Tract C-a retort 1, Rio Blanco County, Colorado.** Trudell, L.G.; Mason, G.M.; Fahy, L.J. (Western Research Inst., Laramie, WY (USA)). May 1986. Contract FC21-83FE60177. 153p. NTIS MF A01; 2; GPO Dep. File Number DE87007117.

An investigation was conducted to provide basic data on some of the characteristics of a modified in situ (MIS) oil shale retort after processing. Samples of retort contents and overburden were obtained from three core holes drilled into Rio Blanco's Tract C-a retort 1 in the western part of the Piceance Creek Basin, Colorado. The retort operation had been completed nearly four years before the coring, and the cavity and mine workings had been flooded by groundwater for almost one year. Cores were characterized by lithologic description, x-ray diffraction, and optical microscopy. Drilling and logging records indicate as much as 35 to 40 feet of roof rock has collapsed into the retort since the burn was terminated. A water-filled attic cavity 46 to 62 feet high exists at the top of the retort. One core hole penetrated 377 feet of rubble in the retort and floor rock with numerous fractures below the retort. Most of the material recovered from the retort consisted of highly altered, fused and vesicular rock. Lesser amounts of carbonized, oxidized and moderately heated-altered oil shale were recovered from the upper and lower parts. Raw shale roof fall at the top and unretorted oil shale rubble at the bottom are also present. Thermal al-

teration has produced high-temperature silicate minerals from the original mixtures of carbonate and silicate minerals in the raw oil shale. Adequate material was recovered from the retort contents to provide valuable data on the lithologic, mineralogic, and physical characteristics of the MIS retort. 19 refs., 12 figs., 17 tabs.

22215 (DOE/METC—86/6045, pp 145-154) **Perform research in progress development for hydroretorting of eastern oil shales.** Rex, R.C.; Hu, W.C.S.; Punwani, D.; Lau, F.S.; Roberts, M.J. (Hycrude Corp., Chicago, IL). Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract FC21-85LC11069.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

Research performed by the Hycrude Corporation into several aspects of hydroretorting is summarized. Topics include: results of laboratory scale batch tests, environmental mitigation analysis, processes efficiency improvement, fines gasification tests and sample procurement and preparation.

22216 (DOE/METC—86/6045, pp 155-167) **Beneficiation - hydroretorting research.** Lamont, W.E.; Hanna, J.; Rex, R.C. Jr. Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract FG21-85LC11066.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

Characterization and beneficiation test of twelve US oil shales were completed, and hydroretorting of the raw and beneficiated shales is progressing as planned. Seven Eastern shales and two Western shales responded to MRI flotation processing. The Fischer Assay oil yields of the kerogen-enriched concentrates were 2 to 5 times higher than those of the raw shales. Oil recoveries in the concentrates ranged from about 59% to as much as 91%. Hydroretorting tests completed on raw and beneficiated Alabama (Chattanooga) and Kentucky (New Albany) shales gave oil extractions of over 200% of the Fischer Assay oil yields. Combined beneficiation and hydroretort processing of the two shales was technically successful in substantially increasing oil extraction without the need to treat a large bulk volume of relatively low kerogen content shale in the hydroretorting step. Data available to date have indicated that beneficiation hydroretort processing is applicable to both Eastern and Western US oil shales.

22217 (DOE/METC—86/6045, pp 168-182) **Experimental program to determine the suitability of an in-situ process to recover hydrocarbons from eastern shale.** Carr, V.H.; Downen, J.; Britton, K. (Eastern Shale Research Corp., Shelbyville, IN). Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract FG21-85LC11068.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

The objectives of this project are to determine the suitability of an in Situ process to recover hydrocarbons from eastern shale and to evaluate the environmental impact and make economic projections of such a process. This information along with the information generated by the western in situ projects can be used to determine the future national research needs in this area. Specific project tasks are: site selection and acquisition, permitting, retort design and construction, retort operation and evaluation and reporting.

22218 (DOE/METC—86/6045, pp 183-190) **Indiana oil shale development project.** Flynn, R.J.; Raymond, H.D.; Rayan, C.C.; Weineke, M.H. Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract FG21-85LC11067.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

The objective of this study is to prepare the preliminary design of a 500-barrel-per-day oil shale demonstration plant to be located in southern Indiana. The plant will incorporate an Allis-Chalmers roller grate retort to produce crude shale oil and by-product sulfuric acid. The demonstration facility design includes the associated mine and infrastructures. Construction and operating cost estimates for a two-year demonstration program will be developed.

22219 (DOE/METC—86/6045, pp 191-198) **Radio frequency retorting and modeling.** Inguva, R. (Univ. of Wyoming, Laramie). Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract AC20-85LC11060.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

Results from a program to study radio frequency retorting of oil shales by bench scale reactor experiments and theoretical modeling are reported. A reactor capable of handling high temperatures and high electromagnetic fields has been constructed. Permeability and dielectric measuring devices have also been designed. Computer models of fields and current distributions due to a monopole have been developed and tested against experimental results. A retort model has also been developed.

22220 (DOE/METC—87/6073, pp 388-400) **Design and economic evaluation of an energy-integrated thermal process for recovery of oil from tar sands.** Seader, J.D.; Bezama, R.J.; Chakravarty, T. (Univ. of Utah, Salt Lake City). Oct 1986. NTIS, PC A23/MF A01. File Number DE87001002. (CONF-860717—). Contract FG21-84LC11057.

From 2. tar sand symposium; Jackson, WY, USA (8 Jul 1986).

A process design and economic evaluation was developed for an energy-efficient, two-stage fluidized-bed process for the thermal recovery and conversion of tar-sand bitumen into oil. Plant sizes of 15,000 and 50,000 barrels/day of oil were considered. For the smaller production rate, the total capital investment was estimated to be $137,460,000. The corresponding annual manufacturing cost, including depreciation of fixed capital and assuming mined tar sand at $5.00/ton, was estimated to be $69,572,000, which is equivalent to $14.05/bbl of oil. Further processing of the oil for removal of nitrogen and sulfur would be required to obtain a suitable petroleum refinery feedstock. In the first stage of the process, tar sand particles are pyrolyzed at 475 C and near-ambient pressure, in an atmosphere of recycle gas, to oil vapors and coke, which remains on the sand particles. In the second stage, the coke is burned with air at 575 C and near-ambient pressure to produce combustion gas and clean sand. Most of the heat of combustion is transferred rapidly from the second to the first stage by heat pipes. The design incorporates very efficient heat exchanger networks with the result that the process is energy self-sufficient. A second-law analysis indicates that the process is considerably more efficient than a conventional hot-sand recycle process. 16 references, 3 figures, 7 tables.

22221 (DOE/METC—87/6073, pp 401-418) **Preliminary mathematical model of the pyrolysis of bitumen-impregnated sandstone in a fluidized bed.** Lin, L.C.; Hanson, F.V.; Oblad, A.G. (Univ. of Utah, Salt Lake City). Oct 1986. NTIS, PC A23/MF A01. File Number DE87001002. (CONF-860717—). Contract AI01-85FE60731.

From 2. tar sand symposium; Jackson, WY, USA (8 Jul 1986).

The pyrolysis of bitumen impregnated sandstone particles in an isothermal fluidized bed retort has been modeled in this paper. The governing equations describing diffusion and chemical reaction within the tar sand particles were solved analytically using a finite integral transform technique. The analysis gave not only the final distribution of products but also the dynamic response of the product species from the onset of operation. The proper pyrolysis reactor operating temperature can be determined for a given size tar sand particle from the final product distribution and the dynamic response to the variables. 7 references, 6 figures.

22222 (UCID—16986-86-4) **Oil shale quarterly report, October-December 1986.** Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007521.

Progress reports are presented for the following studies: (1) dust; (2) pyrolysis of n-butane; and (3) ammonia from pyrolysis of Devonian oil shale. During this quarter the investigators compared the amount of dust produced by packed bed and fluidized bed processing of shales and also report on work done on the rate of dust generation by raw and processed shale in laboratory fluidized beds.

One factor that contributes to oil yield losses during oil shale pyrolysis is the production of light gases. In order to better understand the fundamental chemistry leading to light gas production, the pyrolysis reaction of simple n-alkanes has been studied. N-butane was chosen as the model system because its cracking products are simple gases. Product gas distribution and selectivity as a result of n-butane cracking over various components typically associated with oil shale (minerals, elements, etc.) was monitored. Using a simple flow reactor, a base case for n-butane cracking (over sand at 540°C) was established for comparison. Ammonia produced during oil generation has evolution kinetics similar to oil. The amount of ammonia produced from char relative to oil depends on the retort design and the experiment. With a rapid inert gas sweep, char formation is limited, but char is still the major precursor of ammonia. Iron is a good catalyst for ammonia decomposition as well as synthesis, and a stainless steel (SS) retort can act as a catalyst. The decomposition of ammonia in a SS retort is compared graphically with the case in a quartz retort. 6 figs., 3 tabs.

22223 **General kinetic model of oil shale pyrolysis.** Burnham, A.K.; Braun, R.L. (Lawrence Livermore Lab., CA). *In Situ;* 9: No. 1, 1-23(1985). Contract W-7405-ENG-48.

A mathematical model for pyrolysis of Green River oil shale is developed from previous experiments on oil, water, and gas evolution and oil cracking over a wide range of pyrolysis conditions. Reactions included are evolution of 5 gas species, oil, and water from kerogen, clay dehydration, oil coking and cracking, and evolution of H_2 and CH_4 from char. Oil is treated in eleven boiling point fractions in order to treat the competition between oil coking and evaporation, and to evaluate the effect of oil cracking on the boiling point distribution of the oil. The kinetics and product yields calculated by the model are compared to experimental results for pyrolysis conditions ranging from isothermal fluid-bed to high-pressure slow-heating-rate retorting. 31 references, 6 figures, 5 tables.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 22198, 23046

22224 **(DOE/FE/60177—2292) Selected elemental distributions as determined by reference retorting of oil shale.** Johnson, L.S. (Western Research Inst., Laramie, WY (USA)). Jul 1986. Contract FC21-83FE60177. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87005813.

In an effort to determine potential hindrances to the commercial development of the oil shale industry mass balance Fischer assay was used as a reference retorting method to examine the distribution of selected elements generally considered as contaminants in the final retort products. The elements examined were nitrogen, sulfur, silver, arsenic, barium, cadmium, chromium, copper, mercury, lead, selenium, and zinc. The shales used in this study were an eastern (New Albany) interim reference shale, a western (Green River Formation) interim reference shale, and a series of stratigraphically differentiated shales from Colorado corehole No. 1 in the Piceance Creek Basin. Analysis of the raw shale and retort products was accomplished using instrumental elemental methods including inductively coupled argon plasma spectroscopy and graphite furnace atomic absorption. Carbon balances indicated a high potential for achieving good mass closures existed. However, instrumental limitations combined with a high potential for contamination and/or representative sampling problems resulted in poor closures for many of the trace elements. Consistent closures were obtained for arsenic, barium, copper, and zinc. Given the operating conditions of the retort all elements under consideration remained primarily in the spent shale. Elements verified in the oil product included nitrogen and sulfur compounds and arsenic and selenium. The water product was also contaminated by nitrogen and sulfur compounds and arsenic and selenium. Evidence suggests the sulfur occurs primarily as organic sulfur. Quantitative results for the gas product were poor. However, sulfur and mercury were determined to be present at significant levels in the gas stream. The data presented here concurs with previously reported data that suggests the existence of several potential problem areas in the development of an oil shale industry. 42 refs., 1 fig., 42 tabs.

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 22220

0410 Environmental Aspects

22225 (DOE/METC—86/6045, pp 208-210) **Acid drainage from eastern oil shales.** Sullivan, P. Aug 1986. NTIS, PC A12/MF A01. File Number DE86006587. (CONF-860847—). Contract AC21-85LC11062.

From 2. annual oil shale contractors' meeting; Morgantown, WV, USA (12 Aug 1986).

The oil shales selected for this study are a New Albany shale (pyritic sulfur 4.9% and 14.9 gallons of oil/ton) and a Chattanooga Shale (pyritic sulfur 1.6% and 12.0 gallons of oil/ton). Each shale was crushed to a 0.5 inches and retorted by WRI using the Paraho process and combusted by J & A Associated using a fluidized bed reactor. These data indicate that both raw shales are toxic and will be a potential acid generator. The retorted Chattanooga shale may also be a potential acid generator.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 24378

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 23058, 23487

22226 **(DEMO—82/3G) Car-borne scintillometer survey in Thessaly and Euboea Island.** Pippos, H.S. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). 1983. 98p. (In Greek). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701614.

This report presents the radiometric survey of Thessaly and Euboea Island (Central Greece) conducted in 1979-1980 where the car-borne-scintillometer survey (CBS) method was mainly employed. The research aimed at locating areas or spots of high radioactivity and covered 52 map sheets (scale 1:50,000). In the investigated area of 22,799 km/sup 2/ in total pertaining to five consecutive geotectonic unities, i.e. the Ionian, Gavrovo, Olonos-Pindos, Subpelagonic and Pelagonic, have been located 23 anomalies exhibiting high radioactivity from 3 to 375 times the background being described in detail. Their geologic and radiometric relation is pointed out and suggestions on the probable causes of their formation are made. The highest content of solvable U traced in argillaceous lignites of the Kymi region (Euboea) is of 20.8 ppm. A further detailed investigation of the most promising areas is suggested. (N.Ch.).

22227 **(DEMO—83/7G) Uraniferous lignites and bituminous clays of the Serres Basin. Pt. A.** Karystinaios, N.; Sideris, G.; Siatos, G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jun 1983. 50p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701496.

The lignites of the southern area (Christos-Vissiani-Lefkes-Perdikari) and the bituminous clay silts of the northern area (Maramena, Ano Metohi, Chrysopigi) are the main uraniferous beds in the Serres Basin. The sediments of the basin (Upper Miocene to recent) have been stratigraphically divided into three informal unities: the Lefkon, Georgios and Spilia formations. The uraniferous lignites pertaining to the Lefkon limnic-fluvial formation are developed into two discrete horizons, the upper Double Seam and the lower Main Seam. The bituminous clays are of the same age with the lignites, those of Maramena being, however, younger, equivalent to the marine and brackish Georgios formation. The continuity, thickness and dip of the strata reveal considerable regional changes resulting from the intense tectonism of the basin. Further to the surface works the upper lignites have been reached through small excavations and also about 100 boreholes totalling 10,000 m have been drilled. The composition of the organic constituents and the

calorific value show a dull transitional to shiny hard lignite with ash rich in pyrite and sulphur. There have been no discrete U minerals detected, while the electron microprobe analysis showed that the uranium is uniformly disseminated into the lignite mass, mainly absorbed through its humic acids. More than 75% of the uranium is extractable, the control of its combustion conditions being, however, a major problem. The potential reserves have been up to date estimated to be of over 4,000 tons (uranium metal), this figure resulting mainly from data evaluated from the borehole γ-ray logs using the computer programmes LOGFILE and LOGPLOT developed at the Radioactive Raw Materials Dept. of the Greek AEC.

22228 **(DEMO—84/4G) Report on the results from the 3rd phase geochemical stream sediment and water sampling in the Vathyrema area (Drama Dept.).** Stavropoulos, A.; Alexiades, T. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jul 1984. 30p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701500.

Within the limits of the seven anomalous subareas discerned by geochemical stream sediment and water sampling (phase 2) in the P/sub 7/ uranium geochemical anomaly (Vathyrema, Drama) detailed geochemical and radiometric surveys aiming at the localization of more concrete anomalous sites have been carried out (phase 3). After having elaborated the histograms and cumulative frequency curves for uranium and γ-radiation and discerned the anomalous populations the construction of geochemical and radiometric maps for each anomalous site has been possible. Proposals for a further in depth investigation in this area are made.

22229 **(DEMO—84/6G) Uranium exploration in Central and Eastern Macedonia and Thrace (Greece). Geology, scintillometry and geochemistry of the map area 2623(I,IV)-2624-2723-2724 Thrace.** Kampanellos, J.; Persianis, D. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jul 1984. 101p. (In Greek). NTIS (US Sales Only), PC A06/MF A01. File Number DE87701501.

In accordance with the agreement between the UN Development Programme, the IAEA and the Greek AEC car-borne scintillometer, ground scintillometer and geochemical stream sediment surveys, along with reconnaissance geological mapping have been carried out within the area of map sheets 2623(I,IV)-2624-2723-2724 (Ormenio-Orestiada-Didymoticho, Evros Dept., Thrace). The results of these surveys, presented in a series of 15 maps, indicate that three areas (Petrota-Pentalofos, Mikro Derio, Petrota) totalling 355 km/sup 2/ will require further detailed examination in order to test their potential of economic uranium deposits. Of these areas the first two (340 km/sup 2/) should be given first priority and be further investigated by detailed stream sediment and water sampling, detailed ground scintillometer measurements, grid soil and radon soil gas samplings, as well as by detailed geological mapping.

22230 **(DEMO—84/8G) Car-borne and on foot scintillometer survey of the Aegean Sea Islands (Greece). Pt. A.** Pippos, H.S. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Oct 1984. 98p. (In Greek). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701503.

The present report deals with the geological, technical and statistical data of the car-borne scintillometer survey (4,750.7 km) of 38 islands and of the on foot radiometry (87.5 km) of 13 islands of the Aegean Sea. Sixty-nine map sheets (scale 1:50,000) have been covered, corresponding to the total surveyed area of 9,464 km/sup 2/. 3 maps; 186 refs. Contains summary in English.

22231 **(DEMO—84/10G) Geology and radiometry of West Macedonia (Greece).** Minatidis, D.G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Oct 1984. 81p. (In Greek). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701505.

Car borne scintillometry survey in W. Macedonia (Greece) showed that the granitic rocks of the area, the zone centered on the Tertiary volcanic rocks of Almopia zone and a large part of adjacent sediments constitute the most promising geological formations for further uranium exploration. Some Tertiary volcanic rocks in the general area centered on the Aegean plate are associated with uranium mineralization and high radioactivity. An attempt has been made to evaluate young Alpine volcanic rocks from uranium exploration point of view on a regional scale by using arithmetic mean radioactivity data from the car borne survey coverage of W. Macedonia, as well as other geological and geochemical data from numerous similar volcanic rocks of the area and other neighbouring areas. In connection with this further exploration of the Tertiary volcanic rocks of W. Macedonia is expected to reveal new uranium deposits in the area. Horizontal or gently dipping sedimentary rocks adjacent to the above mentioned volcanics have a statistical radioactivity higher than that in normal sediments, a fact that may give evidence of the existence or uranium mineralization in deeper horizons in these sediments. To make a comparison with this the existence of 134 ppm of leachable U in sediments of W. Crete Island, 20 to 30 meters below the surface, is reported where the overlying sediments exhibit also a radioactivity higher than in normal sediments. Some structural contacts, in particular the contact between the granite of Florina and the limestones of Krystallopigi (west of Florina), have locally a very high radioactivity. Also an open fault in the Achlada-Papadia area (Florina) exhibits locally a high radioactivity and a high U content. All the above mentioned geological formations are, therefore, proposed for further U exploration.

22232 **(DEMO—85/2G) Uranium exploration in Central and Eastern Macedonia and Thrace (Greece). Geology, scintillometry and geochemistry of the map area 2623(II,III)-2622 Thrace.** Kampanellos, J.; Persianis, D. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jan 1985. 85p. (In Greek). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701507.

In accordance with the Greek AEC Project for Uranium Exploration in Central and Eastern Macedonia and Thrace (Greece) car-borne scintillometer, ground scintillometer and geochemical stream sediment surveys along with reconnaissance geological mapping have been carried out within the area of map sheets 2623(II,III)-2622 (Feres-Lefkimmi, Evros Dept., Thrace). The results of these surveys, presented in a series of 15 maps, indicate that three areas totalling 380 km/sup 2/ require further detailed examination in order to test their potential of economic uranium deposits. Of these areas Kotronia and Dadia-Nipsa-Loutros covering 325 km/sup 2/ should be given first priority and be further investigated by detailed stream sediment and bank soil sampling, detailed ground scintillometer measurements, grid soil and radon soil gas samplings, as well as by detailed geological mapping.

22233 **(DEMO—85/11G) Car-borne and on foot scintillometer survey of the Aegean Sea Islands (Greece). Pt. B.** Pippos, H.S. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1985. 153p. (In Greek). NTIS (US Sales Only), PC A08/MF A01. File Number DE87701508.

This study being the continuation of a previous report (DEMO 84/8G) gives a detailed description and interpretation of the results of the radiometric survey in general and of the radiometric anomalies more particularly of fifty-one Aegean islands of Greece. The main radiometric anomalies from the point of view of great surface extension and/or high concentration in soluble and/or total uranium are indicated. Further estimation and investigation of the proven uraniferous regions where such anomalies have been traced are suggested. 20 maps; 212 refs. Contains summary in English.

22234 **(DEMO—86/1G) Uranium exploration in Central and Eastern Macedonia and Thrace (Greece). Geology, scintillometry and geochemistry of the map area 2523-2522 Thrace.** Kampanellos, J.; Persianis, D. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Feb 1986. 109p. (In Greek). NTIS (US Sales Only), PC A06/MF A01. File Number DE87701509.

In accordance with the Greek AEC Project for Uranium Exploration in Central and Eastern Macedonia and Thrace (Greece) car-borne scintillometer, ground scintillometer and geochemical stream sediment surveys along with reconnaissance geological mapping have been carried out within the area of map sheets 2523-2522 (Alexandroupolis-Aesymi, Evros Dept., Thrace).

The results of these surveys, presented in a series of 15 maps, indicate that five areas totalling 632 km/sup 2/ require further detailed examination in order to test their potential of economic uranium deposits. Of these areas Nea Santa-Kechros-Chloi-Goniko-Kallithea-Leptokarya, Kirki-Kizari-Aesymi and Drosia-Fillyra-Darmeni should be given first priority and be further investigated by detailed stream sediment and bank soil sampling, detailed ground scintillometer measurements, grid soil and radon soil gas samplings, as well as by detailed geological mapping.

22235 (INIS-mf—10575, pp 244-252) **Determination of nitrogen oxides in gaseous products of uranium ore pressure leaching.** Maly, J. (Ceskoslovensky Uranovy Prumysl, Straz pod Ralskem. Ustredni Laboratore). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The method of sampling from the autoclave, instrumentation used and the conditions of analysis are discussed. The analysis of gaseous products was performed using a gas chromatograph. The relative determination error was +-5% in the total series of results. Oxygen and oxides were determined in the products. (J.C.).

22236 (INIS-mf—10581, pp 86-88) **Studies of uranium deposits in the Alligator River region using PIXE and PIGME.** Gray, D.J.; Davey, B.G.; Duerden, P. (Sydney Univ., Australia. Dept. of Soil Science; Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The distribution of 27 elements in some drill core from the Ranger and Jabiluka uranium ore deposits in the Northern Territory, Australia is described. The distribution of many of these elements is found to be strongly influenced by the weathering process. Many strong simple correlation coefficients were found amongst the elements analysed. Some of the very large values of the correlation coefficients between some of the major and trace elements appear to have a geochemical explanation. Many of the correlations and some of the multiple linear regression equations were not interpretable in terms of the known geochemistry of the deposits and the minerals identified in the samples. These strong statistical relationships arise from the diverse nature of the samples analysed (varying from unweathered rock to highly weathered soils) and cannot be interpreted geochemically because the samples are drawn from systems in which different geochemical processes are operative.

0504 Feed Processing

REFER ALSO TO CITATION(S) 23000

22237 **(LUTKDH/TKKA—1003-1-13(1986)) Purification of wet process phosphoric acid by solvent extraction with long-chain aliphatic amines .** Stenstroem, S. (Lund Inst. of Tech. (Sweden). Dept. of Chemical Engineering). Sep 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750905.

Purification of phosphoric acid by solvent extraction with long-chain aliphatic amines is investigated. Extraction of cadmium is extensively examined regarding the importance of the aqueous phase, the diluent and the amine. The solubility of tri-n-octyl-amine is determined in water and phosphoric acid solutions. Properties of valuable constituent such as uranium and yttrium are screened. Modelling of the system is performed by adapting Bromley's model for electrolytes to the different dissociation/association equilibria in the aqueous phase. In the organic phase simple expressions are used for the non-ideal behaviour. Amine-acid equilibria are investigated for all acids present in industrial phosphoric acid. New extraction constants are calculated for phosphoric and hydrofluosilicic acid. Calculations are compared with experiments both from binary and multicomponent acid mixtures.

22238 **(MINTEK-M—236) Effect of particle size and colloid stability on the wet high-intensity magnetic separation of uranium from cyanidation residues.** (Council for Mineral Technology, Randburg (South Africa)). 15 Jan 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701449.

This report describes an experimental investigation on the magnetic separation of U/sub 3/O/sub 8/ from various size fractions of uranium-gold tailings. High recoveries were obtained at high grades, even from the finest fraction (smaller than 25μm), and an increase in magnetic field did not improve the efficiency of separation. The use of theoretical models did not lead to the correct prediction of the limiting particle size recoverable by magnetic separation. It was shown that the presence of coarse fractions enhances the recovery of uranium from a very fine fraction, and that 'piggy-back' magnetic separation plays an important role in the capture of slimes. The results also showed that the use of a dispersant considerably improves the selectivity of the separation.

0505 Uranium Enrichment

22239 **Science, technology, and the industrialization of laser driven processes.** Davis, J.I.; Paisner, J.A. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA). pp 78 of Digest of technical papers from the OSA/IEEE 1985 conference on lasers and electro-optics. Washington, DC; Optical Society of America (1985). (CONF-850558—).

From Conference on lasers and electro-optics; Baltimore, MD, USA (21 May 1985).

The uranium atomic vapor laser isotope separation (U-AVLIS) process under joint development by Lawrence Livermore National Laboratory and Martin Marietta Engineering Systems, Inc. is currently performing commercial scale tests of its enrichment technologies. The U-AVLIS process morphology, i.e., the relationship between the underlying physics and the process technologies that bear on engineering costs, is discussed.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 22332, 22341, 22343, 22344, 22924, 23443

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 22262, 22296, 22332, 23194, 23443

22240 **(HEDL—7651) Release of fission products from irradiated SRP fuels at elevated temperatures: Data report on the second stage of the SRP source term study.** Woodley, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76FF02170. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007695.

The measurements of the release of fission products from irradiated Savannah River Plant (SRP) fuels at elevated temperatures reported herein extend the results of the first stage of the investigation to two additional fuel temperatures. In the first stage, two types of SRP fuels, a uranium-aluminum alloy designated MK-16 and a U_3O_8-aluminum cermet designated OX-2, were exposed to one of three different atmospheres, argon, air, or 80% steam-20% argon, at either of two different temperatures, 700 or 1100°C. In the second stage, the two fuels and three atmospheres remained the same, but the fuel temperatures, 850 and 1000°C, were intermediate to those previously employed. For each set of conditions, the measurements were repeated and, thus, the second stage of the study, like the first, consisted of 24 separate runs. This report presents the results of the 24 second-stage measurements.

22241 **(IFE/KR/E—86/005) Reprocessing of spent fuel, Dounreay and fast breeder reactors.** Lingjaerde, R. (Institute for Energy Technology, Kjeller (Norway)). Nov 1986. 32p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750896.

In the light of the public interest in Norway in the breeder reactor fuel reprocessing plant projected in Dounreay, Scotland, the report gives a description of the research center in Dounreay and the planned joint European demonstration facility (EDRP). Certain aspects of the fast breeder reactor are also explained.

22242 **(INIS-mf—10346) Kinetic data determination by means of the analytical ultracentrifuge, for optimization of the PUREX process.** Friehmelt, V. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Anorganische und Analytische Chemie). 1986. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751329.

As the uranyl nitrate uptake by the organic phase requires the formation of the extractable species in the form of the neutral UO/sub 2/(NO/sub 3/)/sub 2/ 2TBP complex, addition of nitric acid or neodymium nitrate, which increases the nitrate concentration in the acqueous phase, enhances the extraction of uranium. In contrast to this, uranium distribution coefficients decrease with the removal of nitrate groups from the solution, which happens upon addition of zirconyl nitrate which is converted to Zr(NO/sub 3/)/sub 4/. Uranium addition produces a decrease of distribution coefficients of all fission elements, due to the competing reaction in the organic phase which reduces the number of free TBP molecules because of formation of a very stable complex with the uranyl nitrate. The kinetic studies using the analytical ultracentrifuge have shown that the removal of the complexes formed due to the diffusion in the organic phase, is the process step determining the velocity of the extraction process. Time-dependent concentration profiles have been calculated for neodymium nitrate using the diffusion coefficients, and the profiles have been compared with measured curves, the comparison showing good agreement within an error range of +2 p.c.. Addition of Dodecan for diluting the organic mixture accelerates the uranium extraction process by increasing the diffusion velocity of the TBP complexes, and also suppresses uptake of the water containing the dissolved fission or corrosion products.

22243 **(INIS-mf—10533) Methods to determine iodine plate-out.** Hougaard, H.; Solgaard, P.; Zak, W. (Risoe National Lab., Roskilde (Denmark)). Mar 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750674.

A literature study on iodines behaviour after release from irradiated fuel rods and a detailed dscription of the ventilation system in the hot cell facility form the basis of chosen conditions for some preliminary experiments using non-radioactive iodine. The conclusion states that the system is well suited for the purpose as is the method of sampling from the surface of the ventilation duct, while the releasing technique and the chemical analysis has to be further developed, neutron activation analysis being most promising.

22244 **(INR—1901/22/C/B) Studies on degradation and repurification of tributylphosphate solutions used in nuclear fuel reprocessing.** (Institute of Nuclear Research, Warsaw (Poland)). 1981. 108p. (In Polish). Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

The influence of degradation of the Purex-solvent/TBP 30 vol.%-n-paraffins C/sub 10/-C/sub 14// on extraction and reextraction of uranium and some fission products as well as on the resultant solvent contamination was studied. The effect of uranium present in the TBP-n-dodecane on retention of zirconium in the solvent was examined. A new process of decontamination and cleanup of the degraded solvents has been described. Recovery of uranium, reduction of waste volume and repurification of solvents degraded in broad range of doses have been achieved. Reactions of degradation products with reagents used in several stages of repurification procedure are discussed. Composition of the separated products of solvent degradation has been examined.

22245 **(INR—1947/22/C/B) Study of influence of uranium (6) on complexation of plutonium (4) in radiolytically degraded Purex system.** Wronska, T.; Poczynajlo, A. (Institute of Nuclear Research, Warsaw (Poland)). 1982. 34p. (In Polish). Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

Published in 1983.

The studies have been performed on equilibrium distribution of Pu(4) in two phase systems: UO/sub 2/(NO/sub 3/)/sub 2/ - 2.1 x 10/sup -4/M Pu(4) - 1.02 M HNO/sub 3//30 vol. % TBP-n-dodecane, irradiated with gamma doses of 0.5 Mrad, 5 Mrad and 50 Mrad. The fractions of Pu(4) complexed by degradation products in the organic and aqueous phases at various degrees of saturation of extractant with uranium have been calculated. The results obtained enable to indicate in which parts of the Purex technological process the sediments of Pu(4) complexes with the degradation products can be formed. The complexation of Pu(4) by HDBP and H/sub 2/MBP in nonirradiated TBP systems has been also studied. The composition and formation constants of the complexes were determined.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 22263, 22684, 23196, 23202

22246 **(DOE/AL/33218—T8) [Analysis of transportation issues: Eighth bi-monthly report, November-December 1986].** (Western Interstate Energy Board, Denver, CO (USA)). 16 Mar 1987. Contract AC02-85AL33218. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003392.

During the months of November-December 1986, the contractor spent most of its efforts on Task 1 - updates to the "Primer" and Task 7 - conduct two meetings and record the minutes. Work related to routing, which was covered under Tasks 3 and 4, is also discussed.

22247 **(IEAL-R—86-65-Summ.) Spent fuel management strategies in eight countries and applicability to Sweden. Final report. Executive summary.** (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). 29 Oct 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750703.

International Energy Associates Limited (IEAL) undertook this study on behalf of Sweden's National Board for Spent Nuclear Fuel (SKN) from June to October 1986. The purpose of the project was to compare the programs and regulations for the management of spent fuel from nuclear power plants and disposal of high-level radioactive waste in eight countries: Belgium, Canada, the Federal Republic of Germany, France, Japan, Switzerland, the United Kingdom and the United States. This final report includes revisions requested by SKN upon review of the draft report dated in September 26, 1986. The study is presented in three volumes. Volume I (Section 2.0 of the report) consists of detailed country-specific reports on the policies, regulations and strategies for spent fuel and high-level waste management in each of the eight countries. The information contained in these country-specific reports was used as the basis for comparing the options in each country in terms of cost, environmental impact, and public acceptability, and for comparing the policies and regulatory requirements affecting these activities in each country. These comparisons are provided in Volume II (Section 3.0 of the report). Section 3.0 also includes a discussion of the applicability to Sweden of the strategies and policies in the eight countries studied. Finally, Volume III of the report (Section 4.0) presents the laws, regulations and other documents pertinent to spent fuel and high-level waste management in these countries. Descriptive summaries of the documents are provided in Section 4.0, a comparison guide to the documents themselves (the great majority of them in English) which are provided in 15 volumes of appendices.

22248 **(IEAL-R—86-65-Vol.2) Spent fuel management strategies in eight countries and applicability to Sweden. Final report. Comparison of spent fuel management options, policies and regulations and applicability to Sweden .** (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). 29 Oct 1986. 93p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750701.

The spent fuel management activities described in Volume 1 are compared in three areas. The first section summarizes the spent fuel management options being followed in each country and compares those options with regard to cost, environmental impact and public acceptability. Next section reviews and compares national

policies on nuclear power, spent fuel management and high-level waste disposal and assesses their impact on the development and licensing of nuclear power plants. The third section compares the regulatory requirements affecting spent fuel management in terms of their overall spirit and characteristics and in terms of the responsibilities of the utilities and the regulatory authorities. Finally, the last section addresses the applicability to Sweden of the findings from these comparisons, focusing on cost efficiency, health and safety, environmental impact, public acceptance and licensing procedures.

22249 **(IEAL-R—86-65-Vol.3) Spent fuel management strategies in eight countries and applicability to Sweden. Final report. National policies and regulations.** (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). 29 Oct 1986. 111p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750702.

This volume presents the texts of laws and regulations on the management of spent nuclear fuel in eight countries: Belgium, Canada, the Federal Republic of Germany, France, Japan, Switzerland, the United Kingdom and the United States. Reports and articles presented by the governments are also provided which in many cases offer useful descriptions of programs, regulations, and policies. Summary descriptions of each of the documents are presented in this volume. The scope of the materials provided covers policies and regulations on spent fuel storage (wet and dry, at-reactor and centralized), packaging, handling, transportation, reprocessing, and disposal. Types of documents include legislation, decrees and ordinances, regulations and regulatory guidance, statements of policy and important articles. All important nuclear legislation is included whether or not it deals with spent fuel management explicitly. This includes basic atomic energy laws and laws on financial liability, environmental protection, physical security etc. Similarly, regulations and ordinances having broad impact on nuclear activities are included, such as radiation protection, environmental protection and emergency planning requirements, as well as regulations dealing with spent fuel and waste management topics directly. All legal documents provided are currently in effect.

22250 **(SAND—86-2198C) TRANSNET: a user-accessible network of transportation analysis models.** Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870306—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86016109.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Models and associated data bases, developed under the sponsorship of the Department of Energy (DOE) through the Transportation Technology Center at Sandia National Laboratories, have been used to support transportation analysis efforts for specific sites and for the assessments of the impacts of transportation of specific waste forms to processing/storage sites. TRANSNET, an interactive computer network, was developed to allow outside users access to these models. TRANSNET contains the most recent versions of models developed under DOE/TTC sponsorship - code modifications that have been made since the last published documentation is noted to the user on the TRANSNET screens. To permit a greater spectrum of users to utilize the models, considerable attention has been given to making the models user-friendly and in providing default data sets for typical problems. TRANSNET access and use is limited to support of DOE related program activities; for such activities there are currently no access or user charges.

0510 Marketing, Economics, And By-products

22251 **(AREAEE—275) UFRACAM: a computer code for the evaluation of uranium feed requirements and fresh fuel cost items subject to optimum tails assay.** El-Osery, I.A.; Abdel Salam, A.S.; Yasso, K.A. (Nuclear Research Centre, Inshas (Egypt)). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86780489.

The work presented in this paper is a part of an extensive nuclear fuel cycle evaluation program that can serve in fuel cycle optimization and economic evaluation of nuclear power plants. The paper describes the main features of the computer code "UFRACAM" developed for the estimation of uranium feed requirements and charges associated with the preirradiation fuel cycle operations for reactors fueled with enriched uranium fuel. The code incorporates a computer routine which calculates the optimum tails assay that yields minimum cost for the enriched uranium program. The program is so flexible that it allows the user to choose the type of calculations and results he needs. A sample problem with input data and output results description is presented. A complete FORTRAN listing of the computer code is also provided.

0520 Waste Management

REFER ALSO TO CITATION(S) 22247, 22248, 22249, 22326, 22327, 22328, 22329, 22330, 22860, 22937, 22940, 22985, 23047, 23075, 23076, 23177, 23723, 23724, 23725

22252 **(ANL/EES-TM—322) Radioactive waste isolation in salt: Peer review of the Fluor Technology, Inc., report and position paper concerning waste emplacement mode and its effect on repository conceptual design.** Hambley, D.F.; Russell, J.E.; Whitfield, R.G.; McGinnis, L.D.; Harrison, W.; Jacoby, C.H.; Bump, T.R.; Mraz, D.Z.; Busch, J.S.; Fischer, L.E. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 120p. NTIS, PC E08/MF A01; GPO Dep. File Number DE87006885.

Includes 5 sheets of 24X reduction microfiche.

Recommendations for revising the Fluor Technology, Inc., draft position paper entitled Evaluation of Waste Emplacement Mode and the final report entitled Waste Package/Repository Impact Study include: reevaluate the relative rankings for the various emplacement modes; delete the following want objectives: maximize ability to locate the package horizon because sufficient flexibility exists to locate rooms in the relatively clean San Andres Unit 4 Salt and maximize far-field geologic integrity during retrieval because by definition the far field will be unaffected by thermal and stress perturbations caused by remining; give greater emphasis to want objectives regarding cost and use of present technology; delete the following statements from pages 1-1 and 1-2 of the draft position paper: "No thought or study was given to the impacts of this configuration [vertical emplacement] on repository construction or short and long-term performance of the site" and "Subsequent salt repository designs adopted the vertical emplacement configuration as the accepted method without further evaluation."; delete App. E and lines 8-17 of page 1-4 of the draft position paper because they are inappropriate; adopt a formal decision-analysis procedure for the 17 identified emplacement modes; revise App. F of the impact study to more accurately reflect current technology; consider designing the underground layout to take advantage of stress-relief techniques; consider eliminating reference to fuel assemblies <10 yr "out-of-reactor"; model the temperature distribution, assuming that the repository is constructed in an infinitely large salt body; state that the results of creep analyses must be considered tentative until they can be validated by in situ measurements; and reevaluate the peak radial stresses on the waste package so that the calculated stress conditions more closely approximate expected in situ conditions.

22253 **(BMI/ONWI—623) Potentiometric-level monitoring program, Mississippi and Louisiana: Annual status report for fiscal year 1985.** (Earth Technology Corp., Long Beach, CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Oct 1986. Contract AC02-83CH10140. 90p. NTIS, PC A05. File Number DE87007041.

Potentiometric-level data presented in this report were collected at 82 wells in Mississippi and Louisiana from October 1984 through September 1985. These wells are located near Richton and Cypress Creek Domes in Mississippi and Vacherie dome in Louisiana. Three wells were reinstated to the program during this period. Two previously destroyed wells were deleted from the program. Protective barriers were installed around 26 shallow borings in Mississippi. Cursory analysis of the data in Mississippi indicated minimal, if any, change in potentiometric level during the past year in the Citronelle, Hattiesburg, Cockfield, Sparta, and Wilcox Formations. A slight decline, on the order of 0.3 meter (1 foot), occurred

during the past year in well MCCG-1, which is screened in the caprock of Cypress Creek Dome. The potentiometric level in well MRIG-9, in the caprock of Richton Dome, stabilized during fiscal year 1985 following 5 years of increase. The Catahoula Formation experienced a continuing decline of about 0.3 meter/year (1 foot/year). Well MH-5C, screened in the Cook Mountain Formation, showed a continuing, long-term, upward trend on the order of 1.5 meters (4.9 feet) during the past year. The potentiometric level of well MH-8C, screened in the Cook Mountain Formation, stabilized during fiscal year 1985, following 5 years of large annual increases. Wells screened in the Austin Formation in Louisiana showed a downward trend of 0.3 to 1 meter (1 to 3.3 feet) during fiscal year 1985. Other formations in Louisiana generally showed no change in potentiometric level.

22254 **(BMI/ONWI—632) Technical basis for high-level waste repository land control requirements for Palo Duro Basin, Paradox Basin, and Richton Dome.** Chen, C.P.; Raines, G.E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Feb 1987. Contract AC02-83CH10140. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007042.

Three sites, the Palo Duro Basin in Texas, the Paradox Basin in Utah, and the Richton Dome in Mississippi, are being investigated by the US Department of Energy for high-level radioactive-waste disposal in mined, deep geologic repositories in salt. This report delineates the use of regulatory, engineering, and performance assessment information to establish the technical basis for controlled area requirements. Based on the size of the controlled area determined, plus that of the geologic repository operations area, recommendations of possible land control or ownership area requirements for each locale are provided. On a technical basis, the following minimum land control or ownership requirements are recommended, assuming repository operations area of 2240 ac (907 ha), or 3.5 mi^2 (9.1 km^2): Palo Duro Basin - 4060 ac (1643 ha), or 6.3 mi^2 (16.4 km^2); Paradox Basin - 4060 ac (1643 ha), or 6.3 mi^2 (16.4 km^2); and Richton Dome - 5000 ac (2024 ha), or 7.8 mi^2 (20.2 km^2). Of the factors used to determine the technically based recommendations, one was found to dominate each locale. For the Palo Duro and Paradox Basins, the dominant factor was the need to limit potential radionuclide release by ground-water flow to the accessible environment. For the Richton Dome, the dominant factor was the need to limit the potential effects of solution mining on dome and repository integrity.

22255 **(BNL—39314) Solidification of DOE problem wastes.** Franz, E.M.; Heiser, J.H. III; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 16p. (CONF-860990—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006916.

From 8. annual participants' information meeting of the DOE Low-Level Waste Management Program; Denver, CO, USA (22 Sep 1986).

Sodium nitrate waste has been successfully solidified in two types of polymeric materials: polyethylene, a thermoplastic material, and polyester styrene (PES), a thermosetting material. Waste form property evaluation tests such as ANS 16.1 leaching test and compressive strength measurements were performed on the waste forms containing various amounts of sodium nitrate. A single-screw extruder was employed for incorporating dry waste into polyethylene at its melt temperature of 120°C to produce a homogenous mixture. Results of the leaching test for polyethylene waste forms containing 30, 50, 60 and 70 wt% sodium nitrate are presented as cumulative fraction leached and leaching indices ranging from 11 to 7.8. Two PES systems are discussed. The first is for solidification of dry salt wastes and the second is a water extendible system that is compatible with wet waste streams. Leaching data for PES and water extendible PES waste forms containing 30 wt% sodium nitrate are presented as cumulative fraction leached and leaching indices of approximately 9. Results from compressive strength measurements are also included.

22256 **(BNL-NUREG—39315) Some considerations in the evaluation of concrete as a structural material for alternative LLW [low-level radioactive waste] disposal technologies.** MacKenzie, D.R.; Siskind, B.; Bowerman, B.S.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY (USA); Ecology and Environment, Inc., Buffalo, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-870306—35). NTIS, PC A02 - GPO. File Number DE87006469.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The objective of this study was to develop information needed to evaluate the long-term performance of concrete and reinforced concrete as a structural material for alternative LLW disposal methods. The capability to carry out such an evaluation is required for licensing a site which employs one of these alternative methods. The basis for achieving the study objective was the review and analysis of the literature on concrete and its properties, particularly its durability. In carrying out this program characteristics of concrete useful in evaluating its performance and factors that can affect its performance were identified. The factors are both intrinsic, i.e., associated with composition of the concrete (and thus controllable), and extrinsic, i.e., due to external environmental forces such as climatic conditions and aggressive chemicals in the soil. The testing of concrete, using both accelerated tests and long-term non-accelerated tests, is discussed with special reference to its application to modeling of long-term performance prediction. On the basis of the study's results, conditions for acceptance are recommended as an aid in the licensing of disposal sites which make use of alternative methods.

22257 **(BNL-NUREG—39319) Evaluation of potential mixed wastes containing lead, chromium, or used oil.** Siskind, B.; MacKenzie, D.R.; Bowerman, B.S.; Kempf, C.R.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY (USA); Ecology and Environment, Inc., Buffalo, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-870306—38). NTIS, PC A02 - GPO. File Number DE87006470.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper presents the results of follow-on studies conducted by Brookhaven National Laboratory (BNL) for the Nuclear Regulatory Commission (NRC) on certain kinds of low-level waste (LLW) which could also be classified as hazardous waste subject to regulation by the Environmental Protection Agency (EPA). Such LLW is termed "mixed waste." Additional data have been collected and evaluated on two categories of potential mixed waste, namely LLW containing metallic lead and LLW containing chromium. Additionally, LLW with organic liquids, especially liquid scintillation wastes, are reviewed. In light of a proposed EPA rule to list used oil as hazardous waste, the potential mixed waste hazard of used oil contaminated with radionuclides is discussed. It is concluded that the EPA test for determining whether a solid waste exhibits the hazardous characteristic of extraction procedure toxicity does not adequately simulate the burial environment at LLW disposal sites, and in particular, does not adequately assess the potential for dissolution and transport of buried metallic lead. Also, although chromates are, in general, not a normal or routine constitutent in commercial LLW (with the possible exception of chemical decontamination wastes), light water reactors which do use chromates might find it beneficial to consider alternative corrosion inhibitors. In addition, it is noted that if used oil is listed by the EPA as hazardous waste, LLW oil may be managed by a scheme including one or more of the following processes: incineration, immobilization, sorption, aqueous extraction and glass furnace processing.

22258 **(CONF-870245—4) SWSA [Solid Waste Storage Area] 6 tumulus disposal demonstration.** Van Hoesen, S.D.; Clapp, R.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006607.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A facility to demonstrate the above-grade disposal of solid low-level radioactive wastes (LLW) is being constructed in the Solid Waste Storage Area 6 (SWSA 6) at the Oak Ridge National Laboratory (ORNL). The demonstration facility will utilize the

"Tumulus" technology, which basically involves sealing the waste in concrete vaults, placing the vaults on a grade level concrete pad, and covering the pad with a soil cover after vault placement is complete. Loading of the demonstration unit is scheduled to begin in June, and will continue one to one and a half years until the 28,000 ft^3 capacity is exhausted.

22259 **(CORR—87-0040-Del.Ver.) 200 Area Fault Tree Data Storage and Retrieval System: Area-H, 1/84 to 12/84.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 14 Nov 1986. Contract AC09-76SR00001. 282p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87005891.

22260 **(DOE/CH/10140—03(86-2)) Salt Repository Project: Technical progress report for the quarter 1 January - 31 March, 1986.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1986. Contract AC02-83CH10140. 115p. NTIS, PC A06/MF A01. File Number DE87007043.

This document reports the progress being made each quarter on the development of a geologic repository in salt for the permanent disposal of high-level nuclear waste. The reporting elements are arranged by the work breakdown structure so that related studies are presented together. The studies are reported by the Office of Nuclear Waste Isolation, a prime contractor of the US Department of Energy (DOE) Salt Repository Project Office. The studies include work by other DOE prime contractors and by contractors to the Office of Nuclear Waste Isolation.

22261 **(DOE/NE/44139—28) Decontamination of the extraction sample aisle at the West Valley Demonstration Project.** Vance, R.F. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Sep 1986. Contract AC07-81NE44139. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006872.

This report describes the decontamination and decommissioning (D & D) of the Extraction Sample Aisle (XSA) at the West Valley Demonstration Project. The XSA is one of several areas in the former reprocessing plant required for use in support of the solidification of high-level waste. The XSA contained three glove boxes which housed sample stations. It became radioactively contaminated during fuel reprocessing from 1966 to 1972. This report describes the work performed to accomplish the D & D objectives of removing existing piping and equipment and of reducing radiation and contamination levels, to As-Low-As-Reasonably-Achievable (ALARA) levels for the installation of new equipment. Also reported are pre- and post-radiological conditions, personnel exposure, radioactive waste volume collected, cost and schedule data, and lessons learned.

22262 **(DOE/NE/44139—31) Characterization of the head end cells at the West Valley Nuclear Fuel Reprocessing Plant.** Vance, R.F. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Nov 1986. Contract AC07-81NE44139. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006873.

The head-end cells at the West Valley Nuclear Fuel Reprocessing Plant are characterized in this report. These cells consist of the Process Mechanical Cell (PMC) where irradiated nuclear fuel was trimmed of excess hardware and sheared into short segments; and the General Purpose Cell (GPC) where the segments were collected and stored prior to dissolution, and leached hulls were packaged for disposal. Between 1966 and 1972, while Nuclear Fuels Services operated the plant, these cells became highly contaminated with radioactive materials. The purpose of this characterization work was to develop technical information as a basis of decontamination and decommissioning planning and engineering. It was accomplished by performing remote in-cell visual examinations, radiation surveys, and sampling. Supplementary information was obtained from available written records, out-of-cell inspections, and interviews with plant personnel.

22263 **(DOE/NE/44506—T1) [National Congress of American Indians]: Final 1985-1986 progress report, March 1, 1986-October 7, 1986.** (National Congress of American Indians, Washington, DC (USA)). 1986. Contract FG01-84NE44506;FG01-86RW00110. 385p. NTIS MF A01; 2; GPO Dep. File Number DE87006474.

This quarterly report summarizes the activities of the National Congress of American Indians NCAI Fund program to disseminate information and provide technical assistance to American Indian governments regarding nuclear waste management, site selection and transportation issues. The report covers the grant period March 1, 1986, to October 7, 1986, which includes the no-cost extension granted in March of 1986 and the grant amendment for July 3 to October 3, 1986. During this period, the project held three national meetings of the National Indian Nuclear Waste Policy Committee (NINWPC); monitored the DOE Office of Civilian Radioactive Waste Management (OCRWM) program and congressional activity and provided information to the tribes; published five issues of the Sentinel/Bulletin - NCAI News, which included a number of articles on nuclear waste; provided informational mailings to the NINWPC representatives; attended and coordinated meetings between the tribes, Department of Energy (DOE), Nuclear Regulatory Commission (NRC), the Bureau of Indian Affairs (BIA), Environmental Protection Agency (EPA), and Sandia National Laboratories; and provided speakers to conferences and groups.

22264 **(EUR—9866-Vol.1) Geoprospective study of a nuclear waste repository. Climatology: climatic changes and glaciations.** Courbouleix, S. (Commission of the European Communities, Luxembourg). 1985. 147p. (In French). (BRGM—83-SGN-143-GEO). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751128.

Within the frame of a contract with the CEC dealing with storage and disposal of radioactive wastes in geological formations, the BRGM has been involved in a research on climatic changes and glaciations. For over three million years, the terrestrial environment has undergone a climate crisis, which causes are still discussed. 700,000 years ago, the paroxysm of this crisis was caracterized by the development of big ice-caps in the northern hemisphere. The last important glacial expansion - the Wurm- begun 70,000 years ago and ended less than 10,000 years ago. Since then, the climate warmed up slightly again with the "small glacial age" between the 16th and the 19th centuries. All glaciers regressed during a warmer phase lasting about one century, but, since 1945, the trend is again to a deep in temperature, the climatologists are not able to agree on its causes and its possible develoment. Considering the amplitude and the frequency of the Quaternary climatic changes, it is difficult to think that the glacial crisis is over. Many arguments let suppose the contrary. Therefore, all evidences lead, to the probability of at least one new glaciation wither the next 100,000 years. The problem is to know its importance and when it will occur. If during the present interglacial time, all ices could melt, one can expect a rise sea-levels of about 80 m. On the contrary, in the case of a future glaciation of the same amplitude as the previous one, the stocking of waters by the ice-caps would bring down the sea-level to 120 m which would lead to an important erosion period and a drastic change in landscapes.

22265 **(EUR—9866-Vol.2) Geoprospective study of a nuclear waste repository. Process of erosion and denudation.** Laville, P.; Lajoinie, J.P. (Commission of the European Communities, Luxembourg). 1985. 25p. (In French). (BRGM—83-SGN-541-GEO). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751129.

Within the frame of a contract with the CEC dealing with storage and disposal of radioactive wastes in geological formations, the BRGM has been involved in a research on process of erosion and denudation. The study is based on a literature survey. It shows that the amplitude of relief is the dominant factor to be considered for ranking erosion rates. Extreme figures of 50 and 500mm per 1,000 years are therefore proposed as mean values of erosion rates, respectively for plains-hills and mountains, for indurated rocks and for non-periglacial climates. Coefficients must correct these values when dealing with softer rocks or periglacial climates. All these

factors are liable to change as functions of the surface areas of the morphological units considered.

22266 **(EUR—9866-Vol.3) Geoprospective study of a nuclear waste repository: volcanic activity.** Gadaglia, A.; Varet, J. (Commission of the European Communities, Luxembourg). 1985. 27p. (In French). (BRGM—83-SGN-010-STO). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751121.

The first phase of the prospective study of disposal site evolution consists of analysing the various factors which may influence the repository, for instance the volcanic phenomena. The paper tries to estimate the potential for volcanic activity in France. Hypotheses on the geodynamics of volcanism lead to the conclusion that only the zones of the Chaine des Puys, Vivarais and Mont-Dore can be subject to volcanic activity in the considered timespan. This study was performed under cost-sharing contract with the European Atomic Energy Community in the framework of its R and D programme on "Management and Storage of Radioactive Waste".

22267 **(EUR—9866-Vol.4) Geoprospective study of a nuclear waste repository: salt domes; bibliographic study of their genesis.** Billaux, D.; Robelin, C. (Commission of the European Communities, Luxembourg). 1985. 49p. (In French). (BRGM—83-SGN-657-GEG). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751152.

This report appraises, from the results of a bibliographical study, the possibility of beginning of a domal rise from the salt layer in which or above which would have been placed a repository. The physical mecanisms of salt creep are first screened, together with the factors determining their intensity and relative importance. These factors are primarily the temperature and the state of stress. Semi empirical laws are given for some mecanisms. Present knowledge about the state of the salt in the ground are then examined: we are not able to satisfactorily calculate "in situ" stresses, or to explain the existence of an important shear stress, that has been pointed out by most of the stress measurements. The retrospective study of the genesis of existing domes brings an insight into their correlation with sedimentary and tectonic phases. Model studies help us to interpret the distances between domes, and to explain the scale of this phenomenon. After recapitulating the various factors of some importance, we find that the probability of a dome rise from a previously static layer is low, in the time lap we are interested in (100,000 years). Such a rise would have to be triggered by important changes in the sedimentation, erosion or tectonic activity on the site.

22268 **(EUR—9866-Vol.5) Geoprospective study of a nuclear waste repository. Vertical crustal movements: causes and quantification.** Fourniguet, J. (Commission of the European Communities, Luxembourg). 1985. 56p. (In French). (BRGM—82-SGN-1012-GEO). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751124.

Within the frame of a contract with the CEC, dealing with storage and disposal of radioactive wastes in geological formations, the BRGM has been involved in a research on vertical crustal movements. Units used for the measurements of vertical crustal movements are usually numerous. A single expression is proposed: the Bubnoff unit (1 mm per 1000 years). Vertical movements are due to numerous causes. Volcanism leads to alternative uplift and breakdown. Isostatic compensation of deglaciated areas or connected to deep crustal movements may apply to large areas. Geoidal shape variations give displacements, whose origin is often difficult to explain. Earth tides caused by moon-sun cyclic motion are of low amplitude. Preseismic dilatancy gives sometimes noticable uplift. Earthquakes correspond to deep changes of equilibrium in stresses and may lead to metric surficial deformations. Orogeny and subsidence are long-lived phenomena (several millions years) applying to wide surface (thousands or millions of square kilometers). Measurements of vertical movements are instrumental, thus giving instantaneous values regarding to geological times, or refer to long duration phenomena whose speed is a mean one. A speed given without information on the time span considered and the method used is useless. It is also necessary to mention the geodynamic context: plates boundary, orogenic belt, basin, graben... A collection of data is given classified according to the type of geotectonic province. Speeds of vertical movements range from 1 to 10^6 mm/1000 years; it does exist phenomena able to uplift or low an area of 1 km/1000 years in some paroxysmic cases.

22269 **(EUR—9866-Vol.6) Geoprospective study of a nuclear waste repository taking seismic activity into account.** Godefroy, P. (Commission of the European Communities, Luxembourg). 1985. 159p. (In French). (BRGM—83-SGN-301-GEG). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751154.

This report deals with the problem of taking seismic activity into account for a prospective safety analysis applied to the containment of radioactive wastes in deep geological formations. The first part briefly gives some basic notions of seismicity and specifies the problems and available methods existing to perform predictive analysis related to seismic phenomena. The reliability of the different methods is discussed according to time in consideration: short-term (few centuries to 1,000 y.), mean-term (about 10,000 y.) and long-term (100,000 y. and more). The main features of recent tectonics and seismicity of the European area and France are succinctly exposed in the second part. Qualitative and quantitative data proper to the two selected "test-zones" (massif armoricain and south of bassin parisien) are collected and interpreted to outline the usable hypothesis for a prospective analysis. The probabilistic assessment of earthquake occurrence is discussed in the third part. The fourth part deals with nature and magnitude of the effects of earthquake on underground facilities and with the weight of several factors as those related to seismic sources and geological properties of the site, from a literature review. The following data are taken into account: - damages to underground facilities after great earthquakes, - comparison of seismic records of earthquakes and nuclear events at different depths and at ground surface, - theoretical models developed to determine strains and displacement fields induced by earthquakes. Literature data about the effects of great earthquakes on regional hydrogeology are summarized in the fifth part of the report.

22270 **(EUR—9866-Vol.7) Geoprospective study of a nuclear waste repository. Prospective tectonics: convergent and divergent episodes, evolution of stress during the next 100,000 years.** Gros, Y. (Commission of the European Communities, Luxembourg). 1985. 73p. (In French). (BRGM—83-SGN-210-GEO). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751123.

Within the frame of a contract with the CEC, dealing with storage and disposal of radioactive wastes in geological formations, the BRGM has been involved in a research on prospective tectonics. Within the Western European continental plate, since Mesozoic times, one sees the alternation or succession of convergent and divergent tectonic episodes. These tectonic episodes, although representing geologically discontinuous phenomena, still have time periods of between 4 to 40 millions years. These tectonic phenomena are the cause of the formation or reactivation, at all scales in the continental plate, of brittle, fault-like structures. Tectonic analysis and the in situ measures of stress and the earthquake focal phenomena show that, from the lower Quaternary to the present, the Western European continental plate has been subjected to NNW to SSE convergent stress. A study of the arrangement of European and African plates in the Western Mediterranean shows that the entire region, is undergoing a period of continental collision. The change in the process implies a westerly continental drift of the Spanish plate, a movement which would take several million years. On the Western European scale, the most likely hypothesis during the next 100,000 years is the persistance of the present stress trending approximately N-5. On the other hand, on a local scale, reorganisations of this stress are possible, owing to the presence of tectonic or lithological heterogeneities.

22271 **(EUR—9866-Vol.8) Geoprospective study of a nuclear waste repository. Time dependence of permeability changes.** Billaux, D. (Commission of the European Communities, Luxembourg). 1985. 44p. (In French). (BRGM—83-SGN-189-GEG). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751126.

This paper states the method and the first results of a way to assess the influence of varied geological events on the permeability at a great depth of a fractured rock, to estimate its suitability for future disposal of radioactive wastes. Two sites have been investigated: the granite of FOUGERES and the limestone of the upper Jurassic in the NIVERNAIS. Two types of geological events have been recognized as the most likely to cause drastic changes in the state of stress, and thus in the permeability > a glacial age, and an increase of surface temperature. In both cases, the induced variations of stresses have been found, for three time periods (300, 10,000 and 100,000 years), using maximum hypothesises on the extent of these events, and considering two different behaviours of the ground (coefficient of lateral pressure at rest: 0.5 or 1.0). The changes in permeability have then been computed using a program (PERTRI) based on the modelling of the mechanical behaviour of fractures. The valididy of the results has then been discussed.

22272 **(EUR—9866-Vol.9) Geoprospective study of a nuclear waste repository: simulation of the evolution of a disposal site using a computer code named CASTOR.** Canceill, M.; Courbouleix, S.; Fourniquet, J.; Godefroy, P.; Gros, Y.; Manigault, B.; Peaudecerf, P. (Commission of the European Communities, Luxembourg). 1985. 79p. (In French). (BRGM—84-SGN-229-STO). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751153.

This study was carried out under cost-sharing contract with the Commission of the European Communities in the framework of its R and D Programme on Management and Storage of Radioactive Waste. The objective is to forecast the natural evolution of a disposal site over the future 100,000 years. For this purpose, a computer code named CASTOR was developed. It allows the generation of realistic evolution scenarios. This method was applied to an arbitrarily selected (non-disposal) French site.

22273 **(EUR—9879-Vol.1) Scale effect experiment in a fractured rock mass. Pilot study in the certified Fanay-Augeres mine (F).** Durand, E.; Peaudecerf, P.; Ledoux, E.; De Marsily, G. (Commission of the European Communities, Luxembourg). 1985. 60p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751130.

This report (in two volumes) presents the results of a first phase of research about "scale effect" on permeability and solute transport in a fractured rock mass, to assess its suitability for future disposal of radioactive wastes. The gallery which was "certified" is located in the Fanay-Augeres mine(F), at a depth of about 175 m, in a granite mass. The portion selected for the subsequent experimental work is about 100 m long.

22274 **(EUR—9879-Vol.2) Scale effect experiment in a fractured rock mass. Pilot study in the certified Fanay-Augeres mine (F).** Durand, E.; Peaudecerf, P.; Ledoux, E.; De Marsily, G. (Commission of the European Communities, Luxembourg). 1985. 145p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751131.

This report (in two volumes) presents the results of a first phase of research about "scale effect" on permeability and solute transport in a fractured rock mass, to assess its suitability for future disposal of radioactive wastes. The gallery which was "certified" is located in the Fanay-Augeres mine(F), at a depth of about 175 m, in a granite mass. The portion selected for the subsequent experimental work is about 100 m long.

22275 **(EUR—10023) Mirage project. Second summary progress report (Work period January to December 1984).** Come, B. (ed.). (Commission of the European Communities, Luxembourg). 1985. 191p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87751140.

This report summarizes the second year of work (1984) in the CEC project MIRAGE on migration of radionuclides in the geosphere. It complements CEC reports EUR 9304 (Description of the project) and EUR 9543 (Works carried out in 1983) on the same topic.

22276 **(EUR—10177) Construction of an underground facility for "in-situ" experimentation in the boom clay.** Bonne, A.; Manfroy, P.; Van Haelewijn, R.; Heremans, R. (Commission of the European Communities, Luxembourg). 1985. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751137.

The Belgian R and D Programme concerning the disposal of high-level and alpha-bearing radioactive waste in continental geological formations was launched by SCK/CEN, Mol in 1974. The programme is characterised by its site and formation specific approach, i.e. Mol and Boom clay. In the framework of site confirmation, an important issue is the "in-situ" experimentation which should allow to determine with a higher degree of confidence the numerical value of the data needed for the evaluations, assessments and designs. The present report deals with the construction of an underground experimental facility, which was scheduled to be fully completed in mid 1984. Initially, the completion was scheduled for the end of 1983, but supplementary experiments related to geomechanics and mining capabilities and to be performed during the construction phase of the experimental facility delayed the completion of the underground facility. During the construction, a continuous observation was made of the behaviour of the clay mass and the structures. In this final contract-report, only the as-built structure, the time schedule and the "in-situ" experiments launched or performed during the construction phase are dealt with.

22277 **(EUR—10190) Thermal behaviour of clay formations.** Tassoni, E. (ed.). (Commission of the European Communities, Luxembourg). 1985. 253p. (In Italian). NTIS (US Sales Only), PC A12/MF A01. File Number DE87751148.

The programme carried out by ENEA to model the thermal-hydraulic-mechanical behaviour of the clay formations and the measure, in-situ and in laboratory, the thermal properties of these rocks, is presented. An in-situ heating experiment has been carried out in an open clay quarry in the area of Monterotondo, near Rome. The main goal of the experiment was to know the temperature field and the thermal effects caused by the high level radioactive waste disposed of in a clayey geological formation. The conclusions are as follows: the thermal conduction codes are sufficiently accurate to forecast the temperature increases caused in the clay by the dissipation of the heat generated by high level radioactive waste; the thermal conductivity deduced by means of the "curve fitting" method ranges from 0.015 to 0.017 $W.cm^{-1}.{}^{0}C^{-1}$ - the temperature variation associated with the transport of clay interstitial water caused by temperature gradient is negligible. A laboratory automated method has been designed to measure the thermal conductivity and diffusivity in clay samples. A review of experimental data concerning thermomechanical effects in rocks as well as results of thermal experiments performed at ISMES on clays are presented. Negative thermal dilation has been found both in the elastic and plastic range under constant stress. Thermoplastic deformation appears ten time greater than the thermoelastic one. A mathematical model is proposed in order to simulate the above and other effects that encompass thermal-elastic-plastic-pore water pressure response of clays at high temperatue and effective pressure with undrained and transient drainage conditions. Implementation of the two versions into a finite element computer code is described.

22278 **(EUR—10198) Development of a geophysical methodology from boreholes for the study of radioactive waste repositories in granite formations.** Le Masne, D. (Commission of the European Communities, Luxembourg). 1985. 82p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751125.

Within the frame of a 2-year contract with the C.E.C., dealing with storage and disposal of radioactive wastes in geological formations the B.R.G.M. has been involved in a research on the detection of fracturation from boreholes by geophysical methods. Various geometrical arrays (mono-hole, cross-hole, hole-to-surface) concerning mainly electrical methods, have been used in the field on granitic rocks, and interpreted according to three dimensional earth-models. Conductive or resistivite parallelepipedic inhomogeneities embedded in stratified or homogeneous half-spaces, have been taken into account in this three dimensional modelling. The influence of the various geometrical and electrical parameters of the in-

homogeneities for different electrical arrays has been studied. Advantages and drawbacks of these arrays for the detection of the fracturation from boreholes, can be thus derived. An analysis of the calculation and drawing routines gives way to possible future improvements especially for modelling.

22279 (EUR—10200) Effects of natural heating on a clay formation. Polizzano, C.; Sensi, L.; Leoni, L.; Sartori, F. (Commission of the European Communities, Luxembourg). 1985. 56p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751122.

As a contribution to the characterization of clay deposits as possible sites for nuclear waste disposal, the metamorphic effects induced on Pliocene argillaceous sediments by the small subvolcanic body of Orciatico (Tuscany, Italy) were investigated. In areas close to marginal facies of the magmatic body, where temperatures were presumably ranging from 100 to 500°C, the thermo-metamorphic aureole thickness doesn't exceed 2 meters. In this zone the clay fraction (45-69% of the bulk rock) changes from an illite+illite/smectite interstratified+vermiculite+chloritic intergrades assemblage to a paragenesis characterized only by illite+smectite, the later being the most stable phase among the clay minerals. Within such zone alkalis (Na,K, and Rb) and alkaline-earths (Ca and Sr) result to be the most highly mobilized elements.

22280 (EUR—10215) Mathematical modelling of fracture hydrology. Herbert, A.W.; Hodgkindon, D.P.; Lever, D.A.; Robinson, P.C.; Rae, J. (Commission of the European Communities, Luxembourg). 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751139.

This report reviews work carried out between January 1983 and December 1984 for the CEC/DOE contract 'Mathematical Modelling of Fracture Hydrology' which forms part of the CEC Mirage project (CEC 1984. Come 1985. Bourke et. al. 1983). It describes the development and use of a variety of mathematical models for the flow of water and transport of radionuclide in flowing groundwater. These models have an important role to play in assessing the long-term safety of radioactive waste burial, and in the planning and interpretation of associated experiments. The work is reported under five headings, namely 1) Statistical fracture network modelling, 2) Continuum models of flow and transport, 3) Simplified models, 4) Analysis of laboratory experiments, 5) Analysis of field experiments.

22281 (EUR—10226) Study of the coupling of geochemical models based on thermodynamic equilibrium with transfer models of components in solutions through porous or fissured media. Ribstein-Coudrain, A. (Commission of the European Communities, Luxembourg). 1985. 215p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87751151.

This study is a contribution of analyses possibilities of modelling the transfer of radionuclides from radioactive waste repositories in the underground taking into account complexes geochemical phenomena. The transfer codes describe with a great precision the physical phenomena of transport but they are based on a very simple conceptualisation of the geochemical phenomena of retention by the rock. The geochemical models are interested by a stable unity of volume. They allow to compute the equilibrium distribution of the components between the chemical species of the solution, and the solid and gaseous phases. They use important thermodynamic data bases corresponding to each possible reaction. To sum up the situation about the geochemical codes in Europe and United States, a list of about thirty codes describe their method and potentialities. The principles of a modelisation associating the potentialities of the transport codes and the geochemical codes are discussed. It is not possible to think of a simple coupling. A general code must be established on the bases of the existing codes but also on new concepts and under new constraints. In such studies one must always deal with the problem of the reactions kinetics. When the velocity of the reactions is big enough versus the velocity of transport processes, the assumption of local geochemical equilibrium can be retained. A general code would be very cumbersome, expensive and difficult to use. The results would be difficult to analyse and exploit. On the other hand, for each case study, a detailed analysis can point out many computing simplifications without simplifying the concepts. An example illustrates the problems described before. The studied case is the transfer of a solution through a chalky massif.

22282 (EUR—10227) Coupling of transport and geochemical models. Noy, D.J. (Commission of the European Communities, Luxembourg). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751144.

This report considers mass transport in the far-field of a radioactive waste repository, and detailed geochemical modelling of the ground-water in the near-field. A parallel approach to this problem of coupling transport and geochemical codes is the subject of another CEC report (ref. EUR 10226). Both studies were carried out in the framework of the CEC project MIRAGE. (Migration of radionuclides in the geosphere).

22283 (EUR—10231) Report on intercomparison studies of computer programs which respectively model: I) radionuclide migration II) equilibrium chemistry of groundwater. Broyd, T.W.; McD Grant, M.; Cross, J.E. (Commission of the European Communities, Luxembourg). 1985. 125p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751138.

This report describes two intercomparison studies of computer programs which respectively model: I) radionuclide migration II) equilibrium chemistry of groundwaters. These studies have been performed by running a series of test cases with each program and comparing the various results obtained. The work forms a part of the CEC MIRAGE project (MIgration of RAdionuclides in the GEosphere) and has been jointly funded by the CEC and the United Kingdom Department of the Environment. Presentations of the material contained herein were given at plenary meetings of the MIRAGE project in Brussels in March, 1984 (migration) and March, 1985 (equilibrium chemistry) respectively.

22284 (EUR—10342) Development of computer codes to perform model calculations for thermomechanical interaction of rock salt with borehole liners in a HLW repository. Pudewills, A.; Korthaus, E.; Albers, G.; Biurrun, E.; Schippers, K. (Commission of the European Communities, Luxembourg). 1985. 255p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE87751147.

The principal objectives of the work are the development of computer codes with suitable material laws for rock salt and to perform model calculations on the thermomechanical phenomena in the near field of a radioactive waste repository. In particular the work was dealing with the following subjects: - Comparison of the computational capabilities of the finite element codes ADINA and MAUS (new version) by model calculations for the temperature test field 3. Thermally induced convergence rates of boreholes in a high level waste (HLW) repository. Investigation of the contact between salt and waste containers or borehole liners, and of the resulting pressure rise. Investigation of the effect of inhomogenities (anhydrite layers) in rock salt on the stress-strain field around a borehole in a HLW repository. Development of a material model for backfill material and performance of model calculations on the convergence of backfilled storage rooms or tunnels in rock salt. Development of a new version of the computer code MAUS by the Institut fuer Elektrische Anlagen und Energiewirtschaft of the RWTH-Aachen.

22285 (EUR—10378) Deep fracturing of granite bodies. Literature survey, geostructural and geostatistic investigations. Bles, J.L.; Blanchin, R. (Commission of the European Communities, Luxembourg). 1986. 95p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751127.

This report deals with investigations about deep fracturing of granite bodies, which were performed within two cost-sharing contracts between the Commission of the European Communities, the Commissariat a l'Energie Atomique and the Bureau de Recherches Geologiques et Minieres. The aim of this work was to study the evolution of fracturing in granite from the surface to larger depths, so that guidelines can be identified in order to extrapolate, at depth, the data obtained from surface investigations.

These guidelines could eventually be used for feasibility studies about radioactive waste disposal. The results of structural and geostatistic investigations about the St. Sylvestre granite, as well as the literature survey about fractures encountered in two long Alpine galleries (Mont-Blanc tunnel and Arc-Isere water gallery), in the 1000 m deep borehole at Auriat, and in the Bassies granite body (Pyrenees) are presented. These results show that, for radioactive waste disposal feasibility studies: 1. The deep state of fracturing in a granite body can be estimated from results obtained at the surface; 2. Studying only the large fault network would be insufficient, both for surface investigations and for studies in deep boreholes and/or in underground galleries; 3. It is necessary to study orientations and frequencies of small fractures, so that structural mapping and statistical/geostatistical methods can be used in order to identify zones of higher and lower fracturing.

22286 **(EUR—10398) Corrosion behaviour of container materials for geological disposal of high-level waste. Annual progress report 1984.** Haijtink, B. (ed.). (Commission of the European Communities, Luxembourg). 1986. 154p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87751142.

Within the framework of the Community R and D programme on management and storage of radioactive waste (shared cost action), a research activity is aiming at the assessment of the corrosion behaviour of potential container materials for the geological disposal of vitrified high-level waste. In a joint programme, three promising reference materials are being tested in environments representative of the three considered geological formations, clay, salt and granite. Samples of the three reference materials, Ti-0.2% Pd, Hastelloy C_4 and a low carbon steel were provided by the Commission to the participating laboratories respectively: Studiecentrum voor Kernenergie (SCK/CEN) at Mol (Belgium), Kernforschungszentrum (KfK) at Karlsruhe (Federal Republic of Germany), Commissariat a l'Energie Atomique (CEA) at Fontenay-aux-Roses (France), the Atomic Energy Research Establishment (AERE) at Harwell (United Kingdom) and the Centre National de la Recherche Scientifique (CNRS) at Vitry (France). In this report, the results obtained during the year 1984 are described.

22287 **(EUR—10399) Influence of fluid-rock interaction on the rheology of salt rock.** Spiers, C.J.; Urai, J.L.; Lister, G.S.; Boland, J.N.; Zwart, H.J. (Commission of the European Communities, Luxembourg). 1986. 141p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87751135.

This report documents work done on the rheological and dilatant properties of dry and wet salt during the period 1 November 1981 to 31 December 1983. The report opens with a review of previous evidence and theoretical models for water weakening effects in the long-term creep of salt. The programme was largely designed to look for such effects experimentally. Sections 3 and 4 describe the experimental apparatus and techniques used. Section 5 reports detailed characterization work on the experimental starting material (Speisesalz, Asse, Federal Republic of Germany). Section 6 deals with experiments on the rheological/dilatant properties of dry salt at about 20°C. The results show that even under worst case conditions, creep-induced dilatancy is almost completely suppressed at hydrostatic pressures $>$ 15 MPa. Experiments on the influence of brine are reported in Sections 7 and 8. These show that small amounts of brine (e.g. 0.05 wt% - inherent or added) can cause a significant decrease in the creep strength of salt at low strain rates. This is related to a change in deformation mechanisms from dislocation glide/creep (at normal laboratory rates) to creep involving fluid-assisted recrystallization and diffusional creep (at low rates). The results imply that generally accepted creep laws for salt cannot necessarily be extrapolated to predict long-term behaviour under natural conditions.

22288 **(EUR—10400) Corrosion behaviour of container materials for the disposal of high-level wastes in rock salt formations. Activity report 1983-1984.** Smailos, E.; Schwarzkopf, W.; Koester, R. (Commission of the European Communities, Luxembourg). 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751141.

In 1983-1984 extensive laboratory-scale experiments (immersion tests) to evaluate the long-term corrosion behaviour of selected materials in salt brines and first in situ experiments were performed. In the laboratory experiments the materials Ti 99.8-Pd, Hastelloy C4 and hot-rolled low carbon steel (reference materials in the joint European corrosion programme) as well as cast steel, spheoroidal cast iron, Si-cast iron and the Ni-Resists type D2 and D4 were investigated. The investigated parameters were: temperature (90°C; 170°C, 200°C), gamma-radiation (10^5 rad/h) and different compositions of salt brines. The results obtained show that, in addition to Ti 99.8-Pd, also Hastelloy C4 and unalloyed steels are in principle suitable for being used for long-term stable HLW-containers if the gamma dose rate is reduced by suitable shielding. Furthermore, the susceptibility of Hastelloy C4 to crevice corrosion must be taken into account. Further studies will be necessary to provide final evidence of the suitability of the materials examined. These will mainly involve clarification of questions related to hydrogen embrittlement (Ti 99.8-Pd, unalloyed steels) and to the influence of pressure and saline impurities (e.g. antiJ, antiBr) on corrosion.

22289 **(EUR—10405) Investigations on the populations of introduced and resident micro-organisms in deep repositories and their effects on containment of radioactive wastes.** West, J.M.; Arme, S.C.; Christofi, N.; Philp, J.C. (Commission of the European Communities, Luxembourg). 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751143.

The present study has sought to establish basic facts concerning the importance of microbial presence in a radioactive waste repository. These are: (1) establishing the presence of microbes in relevant geological formations; (2) defining the importance of isolated groups to radioactive waste containment; (3) establishing the ability of sampled microbes to tolerate repository environmental conditions; (4) conducting preliminary work on microbial ability to influence radionuclide migration characteristics; (5) attempting basic modelling of the effects of micro-organisms on containment and radionuclide migration. Results have shown that micro-organisms of significance (e.g. sulphur cycle bacteria) are present in relevant formations. These groups can tolerate repository conditions and influence migration studies. Their growth, however, would seem to be limited by the nutrient availability. Simple modelling has concentrated on conservative calculations on the constraints of maximum effects of microbial contamination of a high-level waste repository.

22290 **(EUR—10437) Assessment of carbon steel overpacks for radioactive waste disposal.** Marsh, G.P.; Bland, I.D.; Taylor, K.J.; Sharland, S.; Tasker, P. (Commission of the European Communities, Luxembourg). 1986. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751136.

The report summarizes the results obtained at Harwell in the second phase of a project evaluating the corrosion behaviour of high-level waste overpacks in geological disposal. It has concentrated on the use of carbon steel in granitic and argillaceous environments, and has aimed at estimating the corrosion allowance required to achieve a 1000-year overpack life. Experimental and mathematical modelling studies have indicated that 200 mm of steel should be more than sufficient to prevent overpack penetration by general or localized corrosion. A theoretical assessment of the possible effects of micro-organisms on overpack corrosion has concluded that such species are likely to be found in repositories, but that only a fraction of their population should be corrosive towards carbon steel. Making the pessimistic assumption that all organic carbon in a 500 mm bentonite backfill is utilized by corrosive sulphate reducing bacteria, it has been estimated that this will result in an additional metal loss of 13 mm. One form of corrosion which cannot be dealt with by the corrosion allowance approach is stress corrosion cracking, since even at the lowest reported propagation rates, a metal thickness exceeding 3 m would be penetrated in 1000 years. It has been concluded that the possibility of stress corrosion cannot be dismissed, but, because the process requires a certain minimum stress level before it can occur, it should be possible to avoid the problem by giving the overpacks a stress relief heat treatment. Tests in a model environment have shown that a heat treatment designed to reduce fabrication stresses to 50% of the yield strengh should be sufficient to prevent cracking. It is recommended that this conclusion be substantiated by scaled-up experiments with

model overpacks. The report draws further attention to degradation by hydrogen embrittlement.

22291 **(FMPC—2079) Start-up and operation of the biodenitrification demonstration facility at the FMPC [Feed Materials Production Center].** Hopper, J.P.; Patton, J.B.; Poff, T.A.; Shanks, P.A. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1987. Contract AC05-86OR21600. 8p. (CONF-870306—42). NTIS, PC A02. File Number DE87006794.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The chemical processes used at the US Department of Energy's Feed Materials Production Center (FMPC) result in waste streams containing high concentrations of nitrates. A fluidized bed biodenitrification system has been designed and constructed to demonstrate that the reduction of nitrates using a production scale reactor is feasible. The technology is based on pilot scale studies performed at the Oak Ridge National Laboratory. Design and construction of a two-column biodenitrification system has been completed at the FMPC. Through the efforts of a dedicated start-up team, and utilizing an operational readiness review methodology, the demonstration facility has been placed in operation. The operation is following a formal performance monitoring and assessment plan. Data collection and performance assessment in the early phases of the demonstration test has been initiated. Preliminary performance results at low flow rates and low nitrate concentrations are presented. Demonstration testing is expected to be completed in June 1987.

22292 **(INIS-mf—10322) Characterization of spent fuel for disposal without reprocessing. Final report.** Wuertz, R.; Ellinger, M. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Jan 1983. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751210.

A characterization of irradiated LWR-fuel was performed as a basis for the radiological assessment of a repository for spent fuel elements. It is intended to exclusively contribute to the description of activity release from fuel elements under accidental conditions in the post-operational phase of a repository. Data were collected on the axial and radial distribution of activity in fuel rods, the macroscopic and microscopic fuel surface, porosity and the chemical state of fission nuclides in LWR-fuels.

22293 (INIS-mf—10573, pp 43-46) **Separation of fission products from high level radioactive wastes by dicarbolide extraction.** Rais, J.; Selucky, P.; Kadlecova, L.; Kyrs, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701488. (CONF-8506335—Pt.3).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Experiences are described with the development of the dicarbolide extraction process for the extraction separation of /sup 137/Cs and /sup 90/Sr. Substantial for the development of the said technology is the chemism of the process and its optimization. The basic technological problems are cited which had to be resolved prior to the preparation of the hot experiment with the actual solution and prior to the design of operating trials. Most problems could be resolved by experiments in laboratory conditions on the basis of mathematical models. This procedure is justified insofar as all possible complicating factors as well as the continuity of key points of technology have been experimentally tried.

22294 (INIS-mf—10577, pp 13) **Sorption of radionuclides on natural materials.** Gulis, G.; Timulak, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

22295 **(INIS-mf—10587) Contamination with radioactive materials and decontamination.** Severa, J.; Bar, J. (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1985. 204p. (In Czech). NTIS (US Sales Only), PC A10/MF A01. File Number DE87701624.

The content of the monograph mainly designed for personnel in nuclear power plants, radiochemical laboratories and laboratories of nuclear medicine departments is basically divided into two parts. In the general part, the contamination of persons and objects with radioactive substances is discussed and the physico-chemical principles of decontamination are presented. The main part of the publication is devoted to concrete practical decontamination procedures. Special attention is devoted to the decontamination of components of nuclear power plants with WWER reactors and to the decontamination of the equipment of radiochemical and radiological laboratories (in-service, after accidents and during decommissioning). Also described is the decontamination of garments, underwear, protective aids, rooms, buildings, terrain and water. Also included is a chapter on the disposal of radioactive wastes generated during decontamination. (A.K.).

22296 **(JAERI-M—85-168) Conceptual design of TRU system engineering test facility, 1. Research and development program.** Matsuzuru, Hideo; Aoyama, Saburo; Suzuki, Katsuhiko; Moriyama, Noboru (eds.). (Japan Atomic Energy Research Inst., Tokyo). Nov 1985. 90p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701582.

In order to promote R/D activities which are necessary to establish back-end technologies of a nuclear fuel cycle, the R/D facility plan needed for above-mentioned objects has been developed and a conceptual design of the facility has been carried out. Taking into account both the national program concerned and the JAERI long-term R/D program, R/D items to be undertaken in the facility have been selected as follows; (1) R/D on treatment technologies specifically for alpha-wastes and safety studies on disposal, (2) R/D on advanced partitioning method, (3) Safety assessment data acquisition for reprocessing processes and R/D on advanced reprocessing process, (4) Studies on irradiated nuclear fuel. This report summarizes detailed R/D program as a part of the conceptual design, in accordance with the basic R/D program established by the task force of TRU System Engineering Test Facility.

22297 **(JAERI-M—86-013) Development of partitioning method: dynamic adsorption characteristics of titanic acid and zeolite mixed column for Sr and Cs ions.** Mori, Ryohei; Yamaguchi, Isoo; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1986. 20p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701584.

A separation method by adsorbing Sr-Cs group on a titanic acid and zeolite mixed column has been adopted in the chemical process of partitioning a high-level fuel reprocessing waste. Dynamic adsorption characteristics of this mixed inorganic ion exchanger column for Sr and Cs ions were studied with a simulated liquid waste. The obtained main results were as follows : Apparent ion exchange capacities of the mixed column were 0.8 — 1.3 meq./g for Sr and 0.13 — 0.22 meq./g for Cs when the simulated liquid waste, which was adjusted to pH 2.0, was treated under column velocity 1 — 10 cm/min. and column temperature 25 — 40 deg C. The volume of the calcined solid waste of Sr-Cs group generated from the partitioning of high-level fuel reprocessing waste was estimated to be 25 — 40 l per 1 ton of spent nuclear fuel. In the experiments with the simulated liquid waste adjusted to pH 5.0, apparent ion exchange capacities for Sr and Cs were 2 — 3 times as much as those in the case of the simulated liquid waste adjusted to pH 2.0. So the estimated volume of the calcined solid waste of Sr-Cs group reduced to 1/2 — 1/3 of that in the case of the liquid waste adjusted to pH 2.0.

22298 **(JAERI-M—86-014) Development of partitioning method. Fundamental study on oxalate precipitation method.** Miyashiro, Hajime; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Feb 1986. 22p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701585.

A partitioning method has been developed under the concepts of separating nuclides in a high-level nuclear fuel reprocessing liquid waste according to their half-lives and toxity and then disposing them by suitable methods. The present paper describes fundamental study on chemical adaptability when a oxalate precipitation method instead of the extraction method with DIDPA (di-isodecyl phosphoric acid) is used for the separation of transuranium elements and rare earths from the high-level liquid waste in the partitioning process. Obtained main results are as follows: Over 99.9% of neodymium, which was used as a representative of transuranium elements and rare earths, could be precipitated by the addition of excess amount of oxalic acid even in no reducing in acidity of a simulated high-level waste. Oxalic acid was partly decomposed during denitration when oxalic acid has been added before denitration with formic acid. A method of dissolving the resultant oxalate precipitate was also examined in the present study.

22299 **(NTB—85-09) Sondierbohrung Boettstein: Hydrogeological testing of crystalline rocks.** Leech, R.E.; Kennedy, K.G.; Gevaert, D. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Dec 1984. 167p. Nagra, Ch-5401 Baden, Switzerland.

In addition to comprehensive studies in geology, geophysics, hydrochemistry and rock mechanics, a three-phased program for (1) drilling (2) testing and (3) monitoring of the twelve boreholes was proposed. The Boettstein borehole is located in the central part of the target areas. It was the first borehole to be drilled. Drilling in the crystalline granitic basement rocks started at a depth of 315 m below ground surface in November 1982 and was completed in December 1983. The monitoring phase is on-going at this time. The study reported herein describes the hydrogeologic testing of the crystalline rocks and results of the work done by Gartner Lee AG (GLAG) in the Boettstein borehole on behalf of Nationale Genossenschaft Fuer Die Lagerung Radioaktiver Abfaelle (NAGRA). This report describes testing equipment and performance. Also included are sections on the testing and analysis methods that were used to determine the hydrogeologic results. Testing was conducted using single and double packer tools with associated down hole and surface electronic equipment. Down hole information from pressure transducers and thermistors were converted from frequency signals to pressure and temperature readings that were printed, plotted and stored on magnetic tape at the surface facility. All the testing equipment worked well. In summary, the hydrogeologic testing activities at the Boettstein borehole were successful in providing information for NAGRA's regional assessment of the crystalline basement rocks. In addition, water samples could be obtained from discrete intervals for geochemical characterization. Continuing ground water monitoring activities at this borehole will add to the data base provided by this report.

22300 **(NUREG—1101-Vol.2) Onsite disposal of radioactive waste: Methodology for the radiological assessment of disposal by subsurface burial.** Neuder, S.M.; Kennedy, W.E. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Feb 1987. 47p. NTIS, PC A03/MF A01 - GPO. File Number TI87900564.

This volume describes the criteria and technical methodology used by NRC staff to evaluate requests by licensees for approval of onsite disposal by burial in soil. The technical methodology includes the ONSITE/MAXI1 code for calculating radiological exposure from various pathways, the MOCMOD84 code, and analytical methods for calculating contaminant transport and concentration of radionuclides in flowing groundwater. Radiological exposure analyses include the following pathways: (1) exposure to direct gamma from any surface contamination or buried waste; (2) drinking water from a well contaminated by migration of radionuclides; (3) ingesting agricultural products derived from radionuclide-contaminated soil; and (4) inhaling radionuclides resuspended at the burial site. Licensee-proposed disposal activities are evaluated in terms of radiological impact on public health and safety and the environment. The estimated committed effective dose equivalent resulting from the technical evaluation will usually be the determining factor in the authorization of the proposed disposal.

22301 **(NUREG/CP—0085) Proceedings of the US Nuclear Regulatory Commission meeting with states on the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985.** Maupin, C.; Schneider, K. (comps.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs). Feb 1987. 166p. (CONF-8606278—). NTIS, PC A08/MF A01 - GPO. File Number TI87900553.

From Meeting with states on the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985; Bethesda, MD, USA (24 Jun 1986).

The purpose of this meeting was to discuss with selected State officials NRC responsibilities under the Low-Level Radioactive Waste Policy Amendments Act, including the approach being taken and progress being made in fulfilling NRC responsibilities. The NRC staff objective was to obtain State views on technical and institutional issues associated with NRC and State implementation of the Act and to determine any additional areas in which NRC can be of assistance in the development of disposal facilities. We believe this objective was accomplished. A transcript of the meeting was made, and it is being published as a NUREG report in order that the information presented and discussed at the meeting may be available to those individuals and groups that have responsibilities under the Low-Level Radioactive Waste Policy Amendments Act for developing disposal capacity and for regulating a low-level waste disposal site.

22302 **(NUREG/CR—4541) Experimental assessment of the sealing effectiveness of rock fracture grouting.** Schaffer, A.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Mar 1987. 188p. NTIS, PC A09/MF A01 - GPO. File Number TI87900560.

The objective of this investigation is to determine the effectiveness of cement grouts as sealants of fractures in rock. Laboratory experiments have been conducted on seven 15-cm granite cubes containing saw cuts, three 23-cm diameter andesite cores containing induced tension cracks, and one 15-cm diameter marble core containing a natural fracture. Prior to grouting, the hydraulic conductivity of the fractures is determined under a range of normal stresses, applied in loading and unloading cycles, from 0 to 14 MPa (2000 psi). Grout is injected through an axial borehole, at a pressure of 1.2 to 8.3 MPa (180 to 1200 psi), pressure selected to provide a likely groutable fracture aperture, while the fracture is stressed at a constant normal stress. The fracture permeability is measured after grouting. Flow tests on the ungrouted samples confirm the inverse relation between normal stress and fracture permeability. The equivalent aperture determined by these tests is a reliable indicator of groutability. Postgrouting permeability measurements as performed here, and frequently in practice, can be misleading, since incomplete grouting of fractures can result in major apparent reductions in permeability. The apparent permeability reduction is caused by grouting of a small area of a highly preferential flowpath directly adjacent to the hole used for grouting and for permeability testing. Experimental results confirm claims in the literature that ordinary portland cement inadequately penetrates fine fractures.

22303 **(NUREG/CR—4735-Vol.1) Evaluation and compilation of DOE waste package test data: Biannual report, December 1985-July 1986.** Interrante, C.; Escalante, E.; Fraker, A.; Kaufman, M.; Liggett, W.; Shull, R. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Science and Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Mar 1987. 131p. NTIS, PC A07/MF A01 - GPO. File Number TI87900568.

This report summarizes results to date of NBS evaluations of Department of Energy (DOE) activities in waste packages designed for containment of radioactive high-level nuclear waste (HLW). The waste package is a proposed engineered barrier that is part of a permanent repository for HLW. Candidate repository sites include three different media: tuff, basalt, and salt. Metal alloys are the principal barriers for the proposed canisters and overpacks. In addi-

tion, borosilicate glass and various packing materials have been proposed as components of this engineered system. Thus, the associated technical problems involve corrosion, leaching, dissolution and transport within the waste packages. This report gives status reports on waste package activities related to each of the three host media. Appended to the report are NBS reviews of selected DOE technical reports and NBS trip reports of pertinent meetings, seminars, and workshop attended. Also presented in the report is background information on the Materials Characterization Center (MCC) as well as discussion on statistical considerations in fitting leaching and corrosion models to measurements. The MCC was established to assess and characterize waste package materials for reliable performance for DOE's nuclear waste needs.

22304 **(NUREG/CR—4825) A preliminary evaluation of the economic risk for cleanup of nuclear material licensee contamination incidents.** Ostmeyer, R.M.; Skinner, D.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management; Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 95p. (SAND—86-2108). NTIS MF A01- GPO. File Number TI87006888.

This report documents an analysis of the economic risks from nuclear material licensee contamination incidents. The results of the analyses are intended to provide a technical basis for an NRC rulemaking which would require nuclear material licensees to demonstrate adequate financial means to cover the cleanup costs for accidental or inadvertant release of radioactive materials. The important products of this effort include (1) a method for categorizing licensees according to the potential cost and frequency of contamination incidents, (2) a model for ranking the categories of licensees according to potential incident costs, and (3) estimates of contamination risk for the licensee categories.

22305 **(OEFZS-A—0902) Occurrence of chlorinated aromatic compounds in filter deposits of an incinerator plant for radioactive waste. Pt. 2. Biological effect of chlorinated polycyclic aromatic compounds.** Bhatia, A.L.; Tausch, H.; Stehlik, G.; Wihlidal, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 19p. (In German). (BL—596/86). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

Limited distribution.

The catalytic chlorination of chrysene, pyrene and fluoranthene yields complex mixtures of partly isomeric chlorine substituted PAHs. Their distribution resembles that of chlorine compounds previously found in filter deposits of an incineration plant for radioactive waste. In the micro fluctuation test these chlorinated products are strong mutagens to Salmonella typhimurium even without enzymatic activation. Frameshift mutations as well as basepair alterations take place.

22306 **(PB—87-138772/XAB) Assessment of state and local notification requirements for transportation of radioactive and other hazardous materials. Final report.** Dively, D.; Morris, F.; Schilling, A.H.; Shen, E.; Allen, J. (Battelle Human Affairs Research Center, Seattle, WA (USA)). 11 Jan 1985. 175p. (BHARC—300/85/001). NTIS, PC A08/MF A01.

State and local laws requiring notification for shipments of radioactive and other hazardous materials have become increasingly common and controversial during the last decade. Such laws are seen by their proponents as essential for planning and emergency response, while their opponents view them as unnecessary and intrusive. The debate over the value of notification requirements has often been hampered by the lack of information about the extent and nature of these laws. The report is intended to present factual information about notification laws in order to facilitate more informed discussion.

22307 **(PNL—4800-Suppl.1) In situ vitrification of transuranic wastes: An updated systems evaluation and applications assessment.** Buelt, J.L.; Timmerman, C.L.; Oma, K.H.; FitzPatrick, V.F.; Carter, J.G. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87007356.

In situ vitrification (ISV) is a process whereby joule heating immobilizes contaminated soil in place into a durable glass and crystalline waste form. Numerous technological advances made during the past three years in the design, fabrication, and testing of the ISV process are discussed. Performance analysis of ISV focuses on process equipment, element retention (in the vitrified soil during processing), melt geometry, depth monitors, and electrodes. The types of soil and waste processed by ISV are evaluated as process parameters. Economic data provide the production costs of the large-scale unit for radioactive and hazardous chemical wastes (wet and dry). The processing of transuranic-contaminated soils are discussed with respect to occupational and public safety. Alternative applications and operating sequences for various waste sites are identified. The technological data base warrants conducting a large-scale radioactive test at a contaminated soil site at Hanford to provide a representative waste form that can be evaluated to determine its suitability for in-place stabilization of transuranic-contaminated soils.

22308 **(PNL-SA—14409) Comparison of alternatives for the treatment of non-fuel-bearing hardware.** Ross, W.A.; Clark, L.L.; Oma, K.H. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 8p. (CONF-870306—31). NTIS MF A01; 2; GPO Dep. File Number DE87006437.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This evaluation compares four alternatives for the treatment or processing of non-fuel-bearing hardware (NFBH) to reduce its volume and prepare it for disposal. These treatment alternatives are: shredding; shredding and low-pressure compaction; shredding and supercompaction; and melting. The alternatives are compared on the bases of system costs, waste form characteristics, and process considerations. The two alternatives with high volume reduction are estimated to save $400 million to $500 million compared with the shredding-only alternative. The study recommends that melting and supercompaction alternatives be considered further and that additional testing be conducted for these two alternatives.

22309 **(PTB-SE—10) Mathematical modelling of the thermal effects of radioactive wastes with low decay heat output on the host rock in the Konrad shaft.** Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Feb 1986. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751207.

If radioactive waste is homogeneously stored in a shaft, the decay heat released by the waste may result in a temperature increase at the chamber walls of 3 K at the most, over a period of 100,000 years. An analytical method has been applied for the study which uses line sources for representing the storage chambers. The temperatures within the storage chambers are calculated by means of a quasistationary approximation. For the radionuclide inventory envisaged for the Konrad shaft (actinide spectrum), the maximum decay heat release and activity levels are determined considering latest measuring results of the thermal parameters of the host rock. This results in a sum criterion which serves as a criterion for verifying whether the thermal loads are kept within the maximum acceptable limits. A summation value is calculated for a given radionuclide inventory, using the given radioactivity limits. If the sum value is less than 1, requirements are met.

22310 **(RHO-WM-EV—16-P) Development of equipment for stabilization and isolation of low-level liquid waste disposal cribs: A descriptive summary.** Phillips, S.J.; Gilbert, T.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1986. Contract AC06-77RL01030. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007396.

A prototypic system that can be used to stabilize and isolate low-level liquid radioactive waste disposal sites has been developed. This system mechanically stabilizes underground waste disposal structures by consolidation of the material within and surrounding the waste zone. Isolation is provided by encasement in a cementitious monolith containing the waste structure and radioactive materials within and in close proximity to the structure. The dynamic

consolidation and grout injection system has been developed and tested at the Hanford Site. Several categories of liquid, low-level waste disposal structures can be treated with the developed system to prevent subsidence and enhance long-term confinement of contaminants.

22311 **(SAND—86-0286) An evaluation of the use of mercury porosimetry in calculating hydrologic properties of tuffs from Yucca Mountain, Nevada.** Klavetter, E.A.; Peters, R.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 154p. NTIS, PC E07/MF A01; 1; GPO Dep. File Number DE87007527.

The geologic formations in the unsaturated zone at Yucca Mountain, on and adjacent to the Nevada Test Site (NTS), are currently being studied for consideration as the host rock for a radioactive-waste repository. Under the direction of the US Department of Energy, the Nevada Nuclear Waste Storage Investigations project is carrying out these studies. The formations are composed of tuffaceous materials, the hydrologic properties of which must be characterized to support analyses of the potential for water and radionuclide movement from the waste canisters to the accessible environment. Pore-size distributions have been determined for tuff samples by means of mercury porosimetry. These pore-size distributions are used in conjunction with capillary-bundle theory to calculate saturated hydraulic conductivities and water saturations as a function of pressure head for tuff matrix materials. The results are compared with those of more direct methods of measurement of these hydrologic properties to investigate the usefulness of employing pore-size distributions, as determined from mercury-intrusion testing, for estimating hydrologic properties of tuffs. The comparisons indicate that pore-size distributions can be useful in estimating saturated hydraulic conductivity values for tuffs from Yucca Mountain, but do not yield good comparisons with data on saturations as a function of pressure head obtained from more direct experimental measurements.

22312 **(SAND—86-7020C) Ventilation planning for a prospective nuclear waste repository.** Wallace, K.G. Jr. (Mine Ventilation Services, Inc., Lafayette, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 25p. (CONF-870212—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007081.

From Annual meeting and exhibition of the Society of Mining Engineers; Denver, CO, USA (24 Feb 1987).

In 1982, the US Congress passed the Nuclear Waste Policy Act to provide for the development of underground repositories for spent nuclear fuel. This development will be managed by the United States Department of Energy. In 1986, the President selected three areas for site characterization to determine their suitability for the development of an underground repository; those sites were: (1) A site in volcanic tuff located at Yucca Mountain in Nevada, (2) a site in bedded salt located in Deaf Smith County in Texas, and (3) a site in basalt located in Hanford, Washington. At present conceptual repository designs are being developed for each site. A key element of a repository design is the underground ventilation system required to support construction, nuclear waste emplacement, and potential waste retrieval. This paper describes the preliminary ventilation systems designed for the repository in tuff. The concept provides separate ventilation systems for the construction and waste emplacement activities. The paper further describes the means by which acceptable environmental conditions will be re-established to allow re-entry into previously closed rooms for the purpose of inspection, maintenance or retrieval.

22313 **(SAND—87-0241) Subseabed Disposal Project thermal response studies: 1985 and 1986 annual report, October 1984 through September 1986.** Percival, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 385p. NTIS MF A01; 2; GPO Dep. File Number DE87007359.

This report documents the Thermal Response Studies conducted by members of the Subseabed Disposal Project during FY85 and FY86. Most of the Thermal Response Studies effort involved the development and testing of the In Situ Heat Transfer Experiment, ISHTE. Early in FY86, funding considerations made it necessary to cancel ISHTE. The total Subseabed Disposal Project was terminated at the end of the same fiscal year with only the preliminary feasibility report efforts being conducted in FY87. The major accomplishments of the Subseabed Thermal Response Studies were: completion of major ISHTE thermal analyses; completion of the ISHTE Ocean Test Cruise; reduction and analyses of Ocean Test Cruise data; and completion of ISHTE documentation.

22314 **(UCRL—94664) Zeolitization of glassy Topopah Spring tuff under hydrothermal conditions.** Knauss, K.G. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 10p. (CONF-861207—81). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006687.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In support of the Nevada Nuclear Waste Storage Investigations Project experiments were conducted to study the effects of heat generated by a nuclear waste repository in densely welded, devitrified tuff on the underlying, compositionally-equivalent glassy tuff at Yucca Mtn. Solid wafers of glassy tuff were reacted with a dilute ground water for several months at 150°C and 250°C at 100 bars pressure in Dickson-type, gold-bag rocking autoclaves. The in-situ chemistry of the hydrothermal fluids was modeled and the chemical affinities for all possible mineral precipitation reactions were calculated using the EQ3/6 program. In the 250°C experiment the calculations suggest that a zeolite mineral would be expected to form. Analyses of the run products showed that not only had the wafer been extensively corroded and the glass shards replaced by clinoptilolite, but pure clinoptilolite had precipitated directly from solution. In the 150°C experiment, although clay minerals were thermodynamically favored to form in the first half of the experiment, by the end of the run a zeolite mineral was predicted to form. Analyses of the run products showed no well-formed secondary minerals (clays or zeolites) had formed. At the lower temperature the effects of precipitation kinetics may preclude the formation of the zeolite within the time span of this experiment. In general the observations are in relatively good agreement with the geochemical model calculations.

22315 **(YJT—86-26) Evaluation of crushed aggregate and sand-bentonite mixtures for application to sealing of the final repository for reactor waste.** Vaajasaari, M.; Saari, K.; Wang Zhen. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Sep 1986. 70p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750679.

The Industrial Power Company Ltd (TVO) is planning to dispose the low- and intermediate level waste from the reactors of the Olkiluoto Nuclear Power Station into the bedrock of Olkiluoto at a depth of approximately 50-100 meters. In the TVO concept the reactor waste is disposed in silo shaped rock caverns. The bituminized waste is packed into steel drums, which are laid into a concrete silo inside the rock cavern. In this study the properties of sands, crushed aggregate and their mixtures with bentonite are reviewed. The applicability of these materials for use as a buffer on the top of the concrete silo is evaluated. This study is based on earlier experimental studies of the materials mentioned before and available literature. Gas production in the silo after disposal is estimated. General concepts of gas conductivity and gas migration in saturated soil are reviewed. The results of this study suggest that crushed aggregate and sand-bentonite mixtures are possible sealing materials for the silo in concern, but the need for further experimental study of their physical and mechanical properties and the gas migration processes through the saturated barrier is emphasized. A program for testing of these properties is presented.

22316 **Fluid relief and check valve.** Blaedel, K.L.; Lord, S.C.; Murray, I. US Patent Application 6-886,491. 17 Jul 1986. 15p. Contract W-7405-ENG-48. DE87007198 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007198.

A passive fluid pressure relief and check valve allows the relief pressure to be slaved to a reference pressure independently of the exhaust pressure. The pressure relief valve is embodied by a submerged vent line in a sealing fluid, the relief pressure being a function of the submerged depth. A check valve is embodied by a vertical column of fluid (the maximum back pressure being a function of the height of the column of fluid). The pressure is vented

into an exhaust system which keeps the exhaust out of the area providing the reference pressure.

22317 **Subsurface disposal of liquid low-level radioactive wastes at Oak Ridge, Tennessee.** Stow, S.H.; Haase, C.S. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). pp 656-675 of Proceedings of the international symposium on subsurface injection of liquid wastes. Dublin, OH; National Water Well Assoc. (1986). (CONF-860307—). Contract AC05-84OR21400.

From International symposium on subsurface injection of liquid wastes; New Orleans, LA, USA (2 Mar 1986).

At Oak Ridge National Laboratory (ORNL) subsurface injection has been used to dispose of low-level liquid nuclear waste for the last two decades. The process consists of mixing liquid waste with cement and other additives to form a slurry that is injected under pressure through a cased well into a low-permeability shale at a depth of 300 m (1000 ft). The slurry spreads from the injection well along bedding plane fractures and forms solid grout sheets of up to 200 m (660 ft) in radius. This subsurface disposal process is fundamentally different from other operations. Wastes are injected into a low-permeability aquitard, and the process is designed to isolate nuclides, preventing dispersion in groundwaters. The porosity into which wastes are injected is created by hydraulically fracturing the host formation along bedding planes. Recent regulatory constraints may cause permanent cessation of the operation. Federal and state statutes, written for other types of injection facilities, impact the ORNL facility. This disposal process, which may have great applicability for disposal of many wastes, including hazardous wastes, may not be developed for future use.

22318 **Considerations of de minimis and exempt quantities.** Meinhold, C.B. (Brookhaven National Lab., Upton, NY). pp 31-37 of Proceedings of the twenty-first annual meeting of the National Council on Radiation Protection and Measurements. Bethesda, MD; National Council on Radiation Protection and Measurements (1986). (CONF-850419—).

From 21. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (3 Apr 1985).

Radioactive waste is perhaps best suited for the application of the de minimis and "exempt" quantities concepts. NCRP's Committee One under the chairmanship of George Casarett has approached the de minimis question from the standpoint of risk. In the current draft document now before the council there is a recognition that even with the prudent assumption of a linear relationship between risk and dose, there must exist a risk and its attendant dose that is negligible. Of primary importance in this issue of developing a de minimis level is the use of risk as the fundamental quantity of importance in deriving such radiation protection recommendations.

22319 **Processing of high-level radioactive waste.** McElroy, J.L. (Pacific Northwest Lab., Richland, WA). pp 84-93 of Proceedings of the twenty-first annual meeting of the National Council on Radiation Protection and Measurements. Bethesda, MD; National Council on Radiation Protection and Measurements (1986). (CONF-850419—). Contract AC06-76RL01830.

From 21. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (3 Apr 1985).

High-level liquid waste (HLW) is traditionally defined as the aqueous phase from the first solvent extraction cycle of nuclear fuel reprocessing. It contains over 99 percent of the non-volatile fission products and unrecovered actinides. Typically wastes streams from subsequent reprocessing steps are concentrated and added to the HLW. The reprocessing of government fuel to recover plutonium and enriched uranium for use in defense programs has been the source of most of the existing HLW in the world, and certainly in the United States. Now, however, the HLW generated in the reprocessing of commercial reactor fuel will become increasingly important since nuclear power has become a major source of electrical power.

22320 **Status of the WIPP - A defense transuranic waste isolation facility.** Weart, W.D. (Sandia National Labs., Albuquerque, NM). pp 94-121 of Proceedings of the twenty-first annual meeting of the National Council on Radiation Protection and Measurements. Bethesda, MD; National Council on Radiation Protection and Measurements (1986). (CONF-850419—). Contract AC04-76DP00789.

From 21. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (3 Apr 1985).

The Waste Isolation Pilot Plant (WIPP) is presently under construction in southeastern New Mexico, 26 miles east of the city of Carlsbad. The WIPP will provide an unlicensed research facility to develop and demonstrate the technology for safe disposal, in salt formations, of those radioactive wastes generated by United States defense programs. Research will be conducted for both transuranic (TRU) and high-level defense wastes (DHLW). The DHLW must be removed after conclusion of the experiments and disposed in a licensed high-level waste (HLW) repository. TRU defense wastes, after an initial five-year "pilot" period during which the waste is readily retrievable, will be permanently disposed in the WIPP.

22321 **Subseabed disposal of high-level radioactive waste.** Gomez, L.S. (Sandia National Labs., Albuquerque, NM). pp 122-132 of Proceedings of the twenty-first annual meeting of the National Council on Radiation Protection and Measurements. Bethesda, MD; National Council on Radiation Protection and Measurements (1986). (CONF-850419—).

From 21. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (3 Apr 1985).

The ultimate disposal of high-level nuclear wastes (HLW) is one of the prime issues that will determine whether or not nuclear power will become a major energy source. In the United States the Nuclear Waste Policy Act (NWPA), Public Law 97-425, establishes a comprehensive policy for the management and disposal of radioactive wastes and spent fuel. This policy mandates that mined respositories will be the first two disposal facilities. In addition, NWPA requires continued investigation of alternative approaches to waste disposal. One of these alternatives involves burying the waste within the clay sediments that lie under approximately 6 km of ocean water. The subseabed alternative is not intended to replace land-based disposal, but rather it is being assessed as a potential future radioactive waste disposal option.

22322 **Magnetic shaft seals prevent hazardous leakage from wastewater agitators.** Traino, F.A. (Monsanto Research Corp., Miamisburg, OH). *Chemical Processing (Chicago);* **48**: No. 14, 146-147(Nov 1985).

The US Department of Energy's laboratory in Miamisburg, OH, operated by Monsanto Research Corporation, processes approximately 45,000 gallons per week of low-level radioactive wastewater to meet Federal Environmental Protection Agency quality standards. Preventing the spread of radioactive contamination throughout the operating area demands effective sealing of all process piping, valves, pumps, and agitators. Rotating shafts of pumps and agitators installed a the start of operations in 1947 were sealed by stuffing glands with graphite impregnated asbestos packing. These pumps proved to be unsatisfactory. In the mid-1970's, new process pumps with mechanical seals and some with magnetic drives were installed. Later, in January 1979, new agitator shaft drives with double tandem, spring-loaded mechanical seals were installed, maintenance of these pumps was costly. The agitator drive shafts were redesigned to accommodate magnetic seals of the type successfully used in blowers and vacuum/pressure pumps in other plant locations. One inherent advantage of the magnetic seal is that it operates with a face loading as much as 50% less than a conventional spring-loaded mechanical seal. The lower loading by a predetermined uniform magnetic force contributes to long face life. Other advantages include compactness, ease of assembly with only a few parts, and insensitivity to vibration. The magnetic shaft seals installed on the agitator shafts in February 1983 are still in service without any leakage or need for maintenance. Based on current operating data and a projected five-year meantime between failures, the estimated cost benefit of the magnetic seals over spring-loaded mechanical seals over spring-loaded mechanical seals will be $640

vs $2400 respectively per seal, with 60% less downtime for maintenance.

22323 **Krypton-85 storage in sputtered-deposited amorphous metals.** Tingey, G.L.; Mc Clanahan, E.D.; Lytle, J.M.; Gordon, N.R.; Knoll, R.W. (Pacific Northwest Lab., Richland, Washington). pp 229-246 of Methods of krypton 85 management. Hebel, W.; Cottone, G. New York, NY; Harwood Academic Pub. (1985). (CONF-8206104—).

From CEC specialists meeting - methods of krypton-85 management; Brussels, Belgium (29 Jun 1982).

After comparing options for storing radioactive krypton gas, the United States Department of Energy selected ion implantation of the gas into a sputter-deposited metal matrix as the reference process. This technique is being developed with pilot-scale testing and further characterization of the deposited product. The process involves implanting krypton atoms into a growing deposit during the sputtering process. An amorphous metal deposit of nominal composition Ni/sub 0.81/La/sub 0.09/Kr/sub 0.10/ has been selected for further studies because of the high krypton loading, high sputtering yield, relatively low cost of the metallic components, resistance to corrosion, and stability of the product. The krypton release from this amorphous metal is described as an activated diffusion process which increases linearly with the square root of time. Studies of krypton release rate as a function of temperature were completed and an activation energy for the diffusion of 70 kcal/mole obtained. From these data, the authors estimated that the krypton release during the first ten years would be 0.5% for a maximum temperature of 350°C. The actual release of the krypton during storage was projected to be lower by a factor of 10/sup 7/ with the maximum temperature only 220°C. Thermal analysis studies show two energy releases occurring with krypton-containing alloys: one associated with recrystallization of the amorphous alloy and a second associated with krypton release. The total energy release between 100 and 800°C was less that 50 cal/g.

22324 **Selenate-selenium sorption on a Columbia River basalt (Umtanum basalt, Washington, U.S.A.).** Ames, L.L.; Salter, P.F.; McGarrah, J.E.; Walker, B.A. (Pacific Northwest Labs., Richland, WA). *Chemical Geology;* **43**: 287-302(1984). Contract AC06-76RL01830.

Sodium selenate and $Na_2{}^{75}SeO_4$ were used with a synthetic groundwater and hydrazine to determine selenate-selenium sorption characteristics of crushed Umtanum basalt between 40 and 60 C. Selenium sorption kinetics from both oxidizing and reducing solutions followed an equation of the type: C/sub I/ - C = Kt/sup b/ where C/sub I/ is the initial selenium concentration in molarity; C is the selenium concentration in molarity at time t in hours; and K and b are constants. Relatively constant b-values of a wide C/sub I/ range allowed K determination over the whole initial concentration range investigated (C/sub I/ = 10^{-5} - 10^{-12} M). Selenium desorption kinetics in 60 C oxidizing systems were described by: C = At/sup d/ where A and d are constants and other quantities defined above. Equilibrium results conformed to a Freundlich sorption isotherm. The enthalpy change was independent of temperature within the range studied and yielded ΔH-values of from +27.23 kcal mol at 1.266 x 10^{-14} mol Se/g basalt to +28.47 kcal mol at 2.061 x 10^{-9} mol Se/g basalt. Chemisorption was indicated by the magnitude of the enthalpy change. Desorption kinetics at 60 C were only modestly less rapid than sorption kinetics, suggesting a relatively small sorption activation energy. Reduced (Eh = -150 to -200 mV) selenium did not desorb. 20 references, 8 figures, 8 tables.

22325 **Effect of aging on the solubility and crystallinity of Np(IV) hydrous oxide.** Strickert, R.G.; Rai, D.; Fulton, R.W. (Pacific Northwest Lab., Richland, WA). *ACS Symposium Series;* No. 246, 135-145(1984). Contract AC06-76RL01830.

From 185. meeting of the American Chemical Society; Seattle, WA, USA (20-25 Mar 1983).

Neptunium(IV) hydrous oxide (NpO_2 x xH_2O) was aged in aqueous suspensions with pH values ranging from 4 to 12. Initially amorphous NpO_2 x xH_2O developed strong X-ray diffraction peaks within one month that corresponded to crystalline NpO_2. The oxidation state analyses of the 1.8 nm filtered solutions showed the Np to be primarily present as Np(V). The solubility of NpO_2 x xH_2O in suspensions at pH values < 8.5 followed the NpO_2 x $xH_2O \rightleftharpoons NpO_2^+ + e^- + xH_2O$ reaction with an apparent log K^o (after 200 days) of -10 +/- 1. The results of the aqueous suspensions with pH values > 8.5 were complicated by the partial conversion of the NpO_2 x xH_2O to an amorphous, oxidized Np solid, and possibly by Np aqueous speciation other than NpO_2OH^o. 13 references, 4 figures, 3 tables.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 22300, 22940, 22985, 23443

22326 **(DOE/EA—0120) Environmental assessment of the F Area decommissioning program, Hanford site, Richland, Washington.** (UNC Nuclear Industries, Inc., Richland, WA (USA)). Oct 1980. Contract AC06-76RL01857. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004905.

The environmental impact of the proposed decommissioning of the 100-F Area is primarily beneficial resulting in the removal and/or stabilization of potentially hazardous and radioactively contaminated structures. Contaminated solid wastes generated as the result of the F-Area decommissioning will be buried in existing burial facilities in the 200 Areas. Contaminated solid wastes generated as the result of the 100-F Area decommissioning will contain about 2% of the existing radionuclide inventory in the 200 Area solid waste burial facilities. (LM)

22327 **(NUREG/CR—3925-Rev.) SWIFT [Sandia Waste Isolation Flow and Transport] II self-teaching curriculum: Illustrative problems for the Sandia Waste-Isolation Flow and Transport model for fractured media.** Reeves, M.; Ward, D.S.; Davis, P.A.; Bonano, E.J. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Jan 1987. Contract AC04-76DP00789. 106p. (SAND—84-1586-Rev.). NTIS, PC E10/MF $6.75 - GPO. File Number TI87006801.

Several documents have been written describing SWIFT II, the most current version of the SWIFT (Sandia Waste Isolation Flow and Transport) code. Reeves et al. [1986a], describes the theory and implementation, and Reeves et al. [1986b], describes the required input of data and parameters, Ward et al. [1984a] and [1984b] describe the comparison of the results from the SWIFT code with data and other existing codes. This document is devoted to assisting the analyst who desires to use the SWIFT II Code. The analyst is referred to the User's Manual for SWIFT II (Reeves et. al. [1986b] for detailed data input instructions. Eight examples are presented to illustrate the use of SWIFT II. The implementation of the numerical simulation of the physical problem is described for each example. For each problem, a listing of the input data and a microfiche listing of the output are provided.

22328 **Probabilistic modeling of radionuclide release at the waste package subsystem boundary of a repository in basalt.** Sugar, B.; Eslinger, P.W.; Baca, R.G. (Rockwell Hanford Operations, Basalt Waste Isolation Project, Richland, WA 99352). *Nuclear Technology;* **75**: No. 3, 338-349(Dec 1986).

Estimation of potential radionuclide releases from the waste package subsystem of a nuclear waste repository is required for two reasons: (a) to judge whether the engineered barrier system complies with the performance regulations prescribed by the U.S. Nuclear Regulatory Commission; and (b) to provide radionuclide source terms needed to predict the isolation performance of the natural barriers (i.e., geologic medium), which must be compared with the U.S. Environmental Protection Agency safety standard. A probabilistic approach developed at the Basalt Waste Isolation Project (BWIP) for the estimation of radionuclide releases from a proposed nuclear waste repository in basalt is presented.

22329 **Americium concentrations in solutions contacting americium-doped glass.** Rai, D.; Schramke, J.A.; Moore, D.A.; Mc Vay, G.L. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *Nuclear Technology;* **75**: No. 3, 350-355(Dec 1986). Contract AC06-76RL01830.

Americium-doped glass (0.053 wt% /sup 241/Am) was contacted with dilute salt solutions (0.001 M NaClO/sub 4/), pH buffers, Permian Basin brine (PBB1), and ten-times-diluted PBB1 to determine the aqueous americium concentrations that can be expected in equilibrium with this glass. The americium concentrations in all of these solutions were similar and decreased with increasing pH; americium concentrations decreased to the detection limit (—10/sup -11.6/ M) at a pH value of —7 and remained at or near the detection limit at pH values > 7. Americium concentrations in glass suspensions with pH >5 were found to be controlled by the dissolution of an americium-solid. The value of the log of the equilibrium constant for the solubility of this americium-solid (Am-solid + 3H/sup +/ = Am/sup 3+/ + H/sub 3/-solid) was determined to be — 10.3. The americium-solid is found to effectively control aqueous americium to very low concentrations under slightly acidic to alkaline conditions. The high ionic strength and the high Cl/sup -/ concentrations in brine are found not to measurably affect the americium-solid solubility. The objectives of the present study were (a) to develop a data base that can be used to predict aqueous americium concentrations in equilibrium with americium-doped glass and (b) to determine the influence of high ionic strength and high chloride concentrations, conditions that are expected in salt repositories, on the leachability or solubility of an americium-containing glass.

0540 Health And Safety

REFER ALSO TO CITATION(S) 22292, 22304, 22318, 22604

22330 **(ORNL/TM—10?16) Inclusion survey contractor implementation plan for fiscal years 1986-1988.** Espegren, M.L.; Carter, T.E.; Little, C.A.; Ramos, S.J. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87007795.

The Radiological Surveys Activities Group (RASA) of Oak Ridge National Laboratory acts as the Inclusion Survey Contractor (ISC) to the Uranium Mill Tailings Remedial Action (UMTRA) Project of the US Department of Energy (DOE). The ISC investigates properties to determine whether the properties qualify for remedial action according to the standards set forth for the UMTRA Project by the US Environmental Protection Agency. The major work elements making up the ISC's activities are: consent form acquisition, land survey/drawing, inclusion survey, post-survey activities, survey report, file transmittal, and recommendation for a vicinity property to be included into or excluded from UMTRAP. The ISC will produce 2960 recommendations in FY 1988 for $3.98M.

22331 **Computer-assisted instruction for nuclear criticality safety.** Blackwell, C. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 291-292(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The task of keeping fissile material handlers current in their criticality safety certification, while necessary and important, can be extremely time consuming for the individuals involved and disruptive to the affected processes. At the Los Alamos Plutonium Facility, this problem has been partially solved by implementing a computer-assisted (CAI) recertification program. A brief description of the system, advantages and disadvantages of the system over the past safety meeting methods, changes in the system since its beginning, and plans for future improvements are presented in the paper.

22332 **Criticality of uranyl-nitrate solution in slab geometry.** Spriggs, G.D.; Hansen, G.E.; Forehand, H.M.; Schlesser, J.A. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 296-297(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Proposed storage arrays for highly enriched uranyl-nitrate solutions produced by Westinghouse Idaho Nuclear Corporation (WINCO) consist of thin rectangular slab tanks separated from adjacent tanks by neutron moderator/isolator materials to maintain a safe subcriticality margin. To validate the criticality codes used by Westinghouse in design of this proposed storage array, Los Alamos National Laboratory, under the auspices of the Office of Nuclear Materials Production of the US Department of Energy (DOE), has designed and performed a series of benchmark experiments at the Los Alamos Critical Experiments Facility (LACEF) intended to simulate the important neutronic characteristics of the array.

22333 **Technique for appraising preventive safety at nuclear facilities.** Russcher, G.E. (Pacific Northwest Lab., Richland, WA). *Transactions of the American Nuclear Society;* **53**: 298-300(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Developing a more effective way to appraise the safety of operating nuclear facilities was the primary objective of a recent study at the Pacific Northwest Laboratory (PNL). This paper summarizes a new technique developed for appraising the safety of nuclear facilities from the viewpoint of safety features that can contribute to accident prevention and hazard control. It evaluates the various systems of an operating nuclear facility to determine how well the facility uses or supports the safety features that are needed to preclude an accident of control a hazard.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 23074

22334 **(IAEA-R—4169-F) Development of a personal computer-based state system of accounting for/and control of nuclear materials. Final report for the period 1 July 1985-30 June 1986.** Markov, A. (International Atomic Energy Agency, Vienna (Austria)). Sep 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87701513.

IBM-PC compatible under DOS.

An IBM-PC and compatible based state system of accounting for and control of nuclear materials under international safeguards (state-level SSAC) is presented. The system works under DOS version 2.0 and above. It consists of a single-module Safeguards Report Editor which is a multi-function menu-driven code written in BASIC. The Editor may be run both in interactive mode and as an EXEC module. The output represents four types of material accounting reports on diskette, suitable for direct input into the IAEA Safeguards Information System (ISIS). In the first part of the report presented, a general description of the system is given. This is complemented with a detailed User Manual where a Guide to Applications, an Operator's Guide, a Programmer's Guide and Listings are included. The system is now available. It is maintained by the Bulgarian Committee on the Uses of Atomic Energy for Peaceful Purposes.

22335 (INIS-mf—10581, pp 29-31) **Go-no go monitors.** Baxter, P.; Boldeman, J.W.; Delaney, I. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Applied Physics Div.). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The IAEA have discussed the need for an NDA instrument to verify that UF/sub 6/ production is within the range of declared enrichment at gas centrifuge plants. The instrument must be capable of making a go-no go decision on whether the enrichment is greater than or less than 20%. It must also be capable of being used during a limited frequency unannounced access inspection of cascade areas. The Go-No Go detector presently being developed uses X-ray spectroscopy to determine the enrichment of the UF/sub 6/ gas in the pipework based on the number of the 185.72 KeV gamma rays emitted from the gas.

22336 (INIS-mf—10581, pp 42-44) **Application of a Portable Briefcase Personal Computer to research reactor safeguards.** Ryan, R.D. (Australian Safeguards Office, Sydney). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The Kookaburra Portable Briefcase Personal Computer (PBPC) has been applied to safeguards inspections at the HIFAR research reactor. A complete portable measuring system provides for non-destructive assay on both fresh and spent fuel. Application programs developed for the PBPC make it possible to immediately analyse the results of the measurements to verify the amounts of nuclear material declared by the operator. This contributes significantly to meeting the essential safeguards criteria of timely detection of diversion.

22337 **(ISPO—210) Surveillance Television and Recording System (STAR): Test, evaluation and implementation activities under POTAS [US Program for Technical Assistance to International Atomic Energy Agency Safeguards] Tasks E.25 and E.54: Final report.** Holt, R.C.; Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (USA). International Safeguards). [1987]. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007350.

The IAEA and Sandia National Laboratories activities, following the completion of the first three Class III STAR Systems in April 1981, are described. These activities led to the IAEA order of 16 Class IV STAR Systems, with the intent to use these systems as a replacement for the Psychotronics CCTV System and for use in other selected applications.

22338 **(LA—10787-PR) Safeguards and security progress report, January-December 1985.** (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87007725.

From January to December 1985, the Los Alamos Safeguards and Security Program was involved in the activities described in the first four parts of this report: Safeguards Operations, Security Development and Support, Safeguards Technology Development, and International Support. Part 1 covers efforts of direct assistance to the Department of Energy and Nuclear Regulatory Commission licensee facilities. This assistance includes consultation on materials accounting problems, development and demonstration of specialized techniques and instruments, and comprehensive participation in the design and evaluation of advanced safeguards systems. In addition, a series of training courses in various aspects of safeguards makes the technology more accessible to those who must apply it. Part 2 treats activities aimed at the security of information and computer systems. Our focus this period was on continuing the activities of the Center for Computer Security, which provides the basis for encouraging and disseminating this emerging technology, and on the development and demonstration of secure computer systems. Part 3 describes the broad development efforts essential to continuing improvements in the practice of safeguards. Although these projects are properly classified as developmental, they address recognized problems that commonly occur in operating facilities. Finally, Part 4 covers international safeguards activities, including both support to the International Atomic Energy Agency and bilateral exchanges. Enrichment plant safeguards and international safeguards for reprocessing plants required a significant portion of our resources. All of these efforts are beginning to provide substantial returns on our investment in technology transfer, not only in raising the level of safeguards effectiveness but also in our benefiting from field experiences in operating environments.

22339 **(LA—10912-MS) An applications guide to vehicle SNM monitors.** Fehlau, P.E. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007707.

The applications guide introduces its readers to the vehicle special nuclear material (SNM) monitors that are becoming part of safeguards and security measures for nuclear material control at DOE facilities. Building on the foundation provided by an applications guide to pedestrian SNM monitors published in 1986 and a technical report on vehicle monitoring published in 1982, the guide provides an overview of vehicle monitoring in Part 1, a discussion of technical aspects of vehicle monitoring in Part 2, and a catalog of vehicle SNM monitors available to DOE facilities in Part 3. Vehicle monitor upkeep, calibration, testing, and performance are important topics in Part 1. The short technical discussion in Part 2 is devoted to new developments and unique features of vehicle monitors.

22340 **(SAND—87-0033) Advanced technology mobile robotics vehicle fleet.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007526.

A fleet of vehicles is being developed and maintained by Sandia National Laboratories for studies in remote control and autonomous operation. The vehicles range from modified commercial vehicles to specially constructed mobile platforms and are utilized as testbeds for developing concepts in the areas of remote control (teleoperation) and computer control (autonomy). Actuators control the vehicle speed, brakes, and steering via manual input from a remote driving station or through some level of digital computer control. On-board processing may include simple vehicle control functions or may allow for unmanned, autonomous operation. Communication links are provided for digital communication between control computers, television transmission for vehicle vision, and voice for local control. SNL can develop, test, and evaluate sensors, processing requirements, various methods of actuator implementation, operator controlled feedback requirements, and vehicle operations. A description of the major features and uses for each of the vehicles in the fleet is provided.

22341 **Assay of holdup in nuclear fuel plants, a review.** Zucker, M.S. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **53**: 192(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Holdup refers to the various forms of special nuclear material (SNM) deposited in process equipment, duct work, surfaces in work areas of plants, etc., in a form such that it is effectively removed from the intended nuclear material flow pattern of normal manufacturing procedures. Often this material is in a form in which it is not easily removable, otherwise it would have been recovered as part of normal periodic cleanout operations. The objectives of holdup measurement are ascertaining the amount, distribution, and how firmly fixed the SNM is. The purposes are varied and include some or all of the following: reconciling a material balance, to decide security requirements in a decommissioned facility, to decide whether recovery efforts are economical, or health and safety, or nuclear criticality control. To meet the needs of holdup assay a number of instruments and measurement techniques have evolved. Experience in measuring holdup indicates that the amount can be minimized and the ease of measurement can be increased by proper plant design. The assay of holdup should be recognized as an integral and normal part of the manufacturing process. Therefore, holdup measurement procedures should be established in advance as part of the engineering development of the process line or manufacturing campaign, and not be allowed to wait until an emergency is declared as is often the case.

22342 **Statistical sampling for holdup measurement.** Picard, R.R.; Pillay, K.K.S. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 193-194(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Nuclear materials holdup is a serious problem in many operating facilities. Estimating amounts of holdup is important for materials accounting and, sometimes, for process safety. Clearly, measuring holdup in all pieces of equipment is not a viable option in terms of time, money, and radiation exposure to personnel. Furthermore, 100% measurement is not only impractical but unnecessary for developing estimated values. Principles of statistical sampling are valuable in the design of cost effective holdup monitoring plans and in qualifying uncertainties in holdup estimates. The purpose of this paper is to describe those principles and to illustrate their use.

22343 **Quantitative estimate of holdup in a plutonium processing facility.** Elmont, T.H.; Maurello-Scott, V. (Rockwell International). *Transactions of the American Nuclear Society;* **53**: 194-195(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The work reported here was done with several goals in mind. The authors wanted to test methods of holdup estimation and to apply that information to future measurements in the process area of their plant. It was desired to quantify measurement biases and develop confidence in holdup measurements. A shutdown of a plutonium recovery operation provided a unique opportunity because their measurements could be compared with results from a cleanup that was scheduled. Several conclusions were drawn from this study. First, a simplistic approach to holdup measurements can produce respectable results quickly at a reasonably low cost. Proper calibration, equipment design, and good experimental plan are needed. Second, holdup can be substantial. Third, process design considerations are very important and efforts should be made during design to reduce opportunity for holdup within process hardware. Fourth, problem areas in the process can be identified and special measurements can be devised for these areas when necessary. Finally, it has been shown that relatively simple and inexpensive instruments (e.g., single-channel analyzers) can be used to give results that are comparable to more sophisticated instruments (e.g, multichannel analyzers), at least for the nearly constant isotopic composition of plutonium in this study.

22344 **Utilization of portable neutron interrogation for in-plant inventory verification.** Menlove, H.O.; Nelson, G.B.; Disselhorst, B.F.; Razvi, J.; Rucker, R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 195-196(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

During the past several years, the active well coincidence counter (AWCC) has been used for the assay of a wide variety of uranium samples. The authors have recently modified the AWCC for the purpose of measuring trays of high-temperature gas reactor (HTGR) fuel rods during in-plant verification by inspectors. The modified AWCC was used for the verification of ~78 trays of HTGR fuel rods at the GA Technologies, Inc. fuel fabrication plant in San Diego, California. The ^{235}U assay was accomplished without removing rods from the trays or breaking the seal on the tray lid.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 22239

0702 Radiation Sources

22345 (EUR—9762-Vol.2, pp 971-978) **Use of ^{7}Li D as target material for the MEDICYC mentions source.** Barjon, R.; Filhol, J.M., Mandrillon, P.; Meulders, J.P.,. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. (In French). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

In the 20-60 MeV required neutron energy range, the use of ^{7}Li D as target material for neutron-therapy purposes is theoritically more efficient than the ^{9}Be one. We have shown that the ^{7}Li D use is technologicaly possible and permits better performances as far as neutron yield and spectrum is concerned especially if the incident protons which have passed the ^{7}Li D half thik target, are deflected by a little permanent magnet. It is the MEDICYC Neutron Source Concept.

22346 (EUR—9762-Vol.2, pp 1019-1027) **Technical modifications at the DT-neutron generator for tumor therapy at Hamburg-Eppendorf.** Hess, A.; Schmidt, R.; Franke, H.D. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The neutron therapy facility (DT, 14 MeV) at Hamburg-Eppendorf has been reconstructed to increase the performance time and the total neutron output of the neutron source. For this reason the active target area was increased by the use of a new designed target system and the mixed deuterium ion beam separated into atomic and molecular ions by a magnetic field. Detailed informations about these modifications are given with a comprehensive discussion of their influence on neutron dosimetry and target data.

22347 **(INIS-BR—580) Techniques of industrial radiology in military explosives.** Alves, L.E.G. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1985. 12p. (In Portuguese). (CONF-8509375—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701619.

From 6. Brazilian seminar of non-destructive tests; Belo Horizonte, Brazil (1 Sep 1985).

The use of industrial radiology techniques id very important for military explosive fabrication. The cylindrical-ogive bodies made in forged metal have their interior fulfilled with high melted explosive and they must explode when they reach the target. The granades, as these bodies are called, are thrown by cannons and their interior are submitted to high pressures and accelerations which can cause a premature detonation, in most case, in interior of tube, in case of they have defects in explosive mass. The origins of defects, its localization and classification presenting the techniques used and disposable in Brazil are discussed. (M.C.K.).

22348 (INIS-mf—10581, pp 70-73) **Industrial applications of radioisotope tracers.** Easey, J.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Isotope Div.). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Radioisotope tracing techniques are powerful tools for analysing the behaviour of large systems and investigating industrially or economically important processes. The results of radioisotope experiments can yield important information, for example, on parameters such as flow rates, mixing phenomena, flow abnormalities and leaks. Some examples of current AAEC research are described, covering studies on hearth drainage in blast furnaces, flow behaviour in waste-water treatment ponds, and sediment transport in marine environments.

22349 **(JAERI-M—86-002) Silicon doping by neutron irradiation.** Horiguchi, Youji; Umei, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1986. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701583.

The report describes a review of research and development about neutron transmutation doping (NTD) techniques which have been carried out in JAERI for the past ten years. The NTD technique can produce phosphor-31 from silicon-30 through the following nuclear reaction, /sup 30/Si (n,r) /sup 31/Si -> /sup 31/P + β/sup -/. The technique provides silicon crystals in which phosphor-31 is homogeneously distributed, and is now widely used all over the world. JAERI started the development of NTD technique in 1975 and then has commercially produced phosphor-31 doped silicon using the technique since July of 1977.

22350 **Switchable radioactive neutron source.** Stanford, G.S.; Rhodes, E.A.; DeVolpi, A.; Boyar, R.E. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 183-184(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

A portable neutron source that can be switched on and off or pulsed at a controllable rate could have a number of uses; as a timely example, it could provide the neutron beam for an (n,γ) interrogator to check luggage for explosives at airports. Other applications include thermal neutron activation and medical diagnostics. Such a source is under design. It employs a radioactive alpha emitter to produce neutrons in an (α,n) reaction, giving it considerable advantages in size, weight, and reliability in comparison with accelerator-based neutron generators, which have bulky ancillary equipment, tend to require frequent maintenance, and do not have a long lifetime in the field. Since a switchable radioactive source can be turned off for transportation and storage, the shielding requirements will be less stringent than for conventional (α,n) and (γ,n) neutron sources, in which the radioactive substance and the neutron emitter are intimately and permanently mixed.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 22353, 22353

22351 **Hydrogen R and D programs of the U.S. Department of Energy.** Brogan, J.J. (Office of Energy Systems Research, Conservation and Renewable Energy, U.S. Dept. of Energy, Washington, DC 20585). pp 37-44 of Proceedings of the international symposium on hydrogen produced from renewable energy. Honolulu, HI; University of Hawaii at Manoa (1984). (CONF-8405122—).

From International symposium on hydrogen produced from renewable energy; Manoa, HI, USA (24 May 1984).

Hydrogen would be an ideal fuel for most applications if it could be produced and stored cheaply. At present, most of the hydrogen produced in the United States is made from oil and natural gas, and is consumed in chemical processes within the same industrial complex where the hydrogen is made. Coal gasification technologies have recently been improved for hydrogen production to meet these industrial needs, and these technologies are being implemented to a limited extent. The breadth of interest in hydrogen by the Department becomes obvious when we consider that hydrogen can be an unwanted decomposition product of water used in cooling nuclear reactors, that fusion energy results from reactions between atoms of hydrogen isotopes (at very high temperatures), and that long-range research is needed to explore ways in which light can be used to decompose water and make hydrogen. These facts indicate that there is a genuine need for research on hydrogen in many organization entities within the Department of Energy.

22352 **A summary status of advanced water electrolysis and hydrogen storage/transport R and D.** Mezzina, A.; Brogan, J.J. (Brookhaven National Lab., Upton, Long Island, NY 11973). pp 229-247 of Proceedings of the international symposium on hydrogen produced from renewable energy. Honolulu, HI; University of Hawaii at Manoa (1984). (CONF-8405122—).

From International symposium on hydrogen produced from renewable energy; Manoa, HI, USA (24 May 1984).

Major projects within the framework of the US DOE Chemical/Hydrogen Energy Systems Program are described. Goals, accomplishments and status of investigations into advanced water electrolysis and hydrogen storage/transport are summarized. Electrolytic hydrogen production systems include: SPE electrolyzers; static feed water electrolysis; high temperature electrolysis; and, anode depolarization concepts. Hydrogen storage R & D for bulk and mobile systems include underground storage, metal hydrides, microspheres, and other advanced concepts. Hydrogen transport studies have emphasized the characterization of hydrogen embrittlement effects on conventional natural gas pipeline steels.

0802 Storage

REFER ALSO TO CITATION(S) 22352, 22352

0803 Transport

REFER ALSO TO CITATION(S) 22352

0806 Industrial And Commercial Use

22353 **Hydrogen as an alternate fuel feedstock.** Smith, C.S. (Solar Energy Research Institute, Golden, CO 80401). pp 303-304 of Proceedings of the international symposium on hydrogen produced from renewable energy. Honolulu, HI; University of Hawaii at Manoa (1984). (CONF-8405122—).

From International symposium on hydrogen produced from renewable energy; Manoa, HI, USA (24 May 1984).

If hydrogen from water splitting using a renewable energy supply were available at sufficiently low cost, very large quantities could be utilized. This, in effect, could move us into a hybrid fossil-renewable technology era for fuel production, without requiring significant changes in the world's fuels utilization infrastructure. The net effect would be to extend our fossil resources and minimize the environmental impacts of their use. Biomass-Hydrogen hybrid technology might well be the ultimate in renewable fuels production. A number of such hybrid conversion concepts are reviewed.

0809 Environmental Aspects

REFER ALSO TO CITATION(S) 22353

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 22370, 22373, 22374, 22376, 23536

22354 (INIS-mf—10578, pp P109) **Factors affecting polyphosphate kinase activity in Acinetobacter calcoaceticus var lwoffi isolated from a five-stage activated sludge plant.** Loetter, L.H.; Schabort, J.C. (Rand Afrikaans Univ., Johannesburg, South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

22355 **(LBL—22911) The effect of salinity on the allocation of carbon to energy-rich compounds in Euphorbia lathyris.** Taylor, S.E.; Skrukrud, C.L.; Calvin, M. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 19p. (CONF-870364—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006942.

From Energy from biomass and wastes; Orlando, FL, USA (16 Mar 1987).

Hydroponically-grown Euphorbia lathyris plants were exposed to increasing levels of NaCl to study the effect of salinity on carbon allocation within the plant. Salinization caused a decrease in overall growth and an increase in the percentage of both hydrocarbons and sugars. The hydrocarbon fraction, containing mostly triterpenoids, increased by 50% and the sugar fraction, containing mostly sucrose, was increased by 88%. This resulted in a shift of available biomass from lignocellulose to the more usable sugars and hydrocarbons. A two-fold increase in the activity (per leaf area) of the enzyme β-Hydroxymethylglutaryl-Coenzyme A Reductase was also observed with increased salinity. This enzyme is involved in the biosynthesis of the triterpenoids, and its response to increased salinity indicates a role for this enzyme in the regulation of plant hydrocarbon productivity. 10 refs., 4 figs., 3 tabs.

22356 **(PNL-SA—14369) Advanced thermochemical biomass gasification.** Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. 20p. (CONF-861146—15). NTIS, PC A02/MF A01. File Number DE87005607.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Development of advanced biomass gasification systems offers the potential for increasing the industrial use of bisomass. An overview of the limitations of thermal gasification systems for producing medium-Btu gas from biomass is presented. The use of an experimental catalytic concept to gasify high-moisture biomass is discussed as a possible means to overcome some of the feedstock limitations of existing gasifier technology. The concept is being developed by Pacific Northwest Laboratory, which is operated for the United States Department of Energy by Battelle Memorial Institute. 17 refs., 1 fig., 5 tabs.

22357 **Partial oxidation of methane with nitrous oxide over V_2O_5-SiO_2 catalyst.** Zhen, K.J.; Khan, M.M.; Mak, C.K.; Lewis, K.B.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **94**: 501-507(1985). Contract AC03-76SF00098.

The partial oxidation of methane to methanol and formaldehyde can be achieved selectively on silica-supported vanadium pentoxide catalysts in the temperature range 460-500°C in a reactant mixture of CH_4, N_2O, and H_2O at 1 atm total pressure. The selectivity to CH_3OH and HCHO can be 100% at 460°C at low conversions (~0.2%) and contact time (1.2 s), and decreases to produce more CO with increasing temperature, contact time, and conversion. The activation energies are 22 +/- 2, 40 +/- 4, and 47 +/- 4 kcal/mole for the production of HCHO, CH_3OH, and CO, respectively. The rate equations are Rate (CH_3OH) ~ (CH_4)/sup 1/2/(N_2O)/sup 1/2/(H_2O)/sup 1/2/, Rate (HCHO) ~ (CH_4)/sup 1/2/(N_2O)/sup 1/3/, and Rate (CO) ~ (CH_4)/sup 1/2/(N_2O)(H_2O)$^{-1}$. The products form by parallel reaction paths which are different from the sequential oxidation mechanism of methane on molybdena and in a lower temperature range than on molybdenum oxide. 5 references, 6 figures, 1 tables.

22358 **Thorium oxide: new catalyst for methanol, isobutanol, and light hydrocarbon production from carbon monoxide and hydrogen.** Maj, J.J.; Colmenares, C.; Somorjai, G.A. (Lawrence Livermore National Lab., CA). *Applied Catalysis;* **10**: 313-316(1984). Contract W-7405-ENG-48.

Thorium oxide has been shown to be an effective catalyst for the production of methanol, isobutanol, and light hydrocarbons from carbon monoxide and hydrogen. The reaction was carried out in a copper-lined tubular reactor, and the effluent gases were analyzed by gas chromatography and time-of-flight mass spectrometry. X-ray photoelectron spectra of used catalyst failed to show any presence of copper; thus, it was concluded that a transition metal with the thoria was not necessary for the reaction as had been previously reported. The main products detected in the effluent gas stream were ethane, ethene, methanol, isobutane, and isobutanol. 13 references, 3 figures.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 22363, 22377

22359 **Large-scale ethanol production from corn and grain sorghum and improving conversion technology.** Turhollow, A.F.; Heady, E.O. (Oak Ridge National Lab., TN, USA). *Energy in Agriculture;* **5**: No. 4, 309-316(Dec 1986).

A linear programming model is used to assess the impacts of large-scale ethanol production from corn and grain sorghum on US agriculture. Annual ethanol production of 22.7 and 45.4 x 10/sup 9/ L, corresponding to approximately 6 and 12%, respectively, of US gasoline consumption is examined. Current conversion technology allows 387 L of ethanol to be obtained from a metric tonne of corn or grain sorghum, and more advanced conversion technology would allow up to 447 L. US agriculture has the capacity to produce both food and large quantities of ethanol. If large-scale ethanol production occurs, the major change in production is the substitution of corn for soybeans in the north central states. With current ethanol production technology, per unit production cost increases for individual crops range from 3 to 12% and from 6 to 30% for annual ethanol production of 22.7 and 45.4 x 10/sup 9/ L, respectively. Advanced ethanol production technology allows crop production costs to be reduced significantly, about 1000 million dollars if 45.4 x 10/sup 9/ L of ethanol are produced. 1 fig., 5 tabs., 10 refs.

22360 **Linear increase in cell volume during the growth cycle of Schizosaccharomyces pombe.** Kubitschek, H.E.; Clay, K. (Argonne National Lab., IL). *American Society for Microbiology Abstracts of the Annual Meeting;* No. 86, 160(1985). Contract W-31-109-ENG-38.

From 85. annual meeting of the American Society for Microbiology; Las Vegas, NV, USA (3-7 Mar 1985).

Classical observations on the growth of cells of the fission yeast Schizosaccharomyces pombe indicate that cell length and volume increase to a maximum value, which is reached about three-quarters of the way through the growth cycle, followed by a constant volume plateau. The authors have reexamined the growth of these cells by phase microscopy. When growth conditions were perturbed by inoculating cells at high density, in the presence of contaminant, or upon agar slips containing the growth medium in 4% agar, all cells grew in the classical pattern. But, at smaller agar concentrations and lower cell densities, many cells grew at a constant rate throughout the entire cell cycle. Also, the frequency of this linear pattern of cell growth increased as growth perturbations were reduced. They interpret these results as evidence for a sensitivity of this microorganism to perturbations of steady-state growth. The constant rate of volume increase throughout the cell cycle in unperturbed cells, when considered along with Mitchison's earlier results for constant dry mass increase, suggests that the buoyant densities of these cells remain constant during the entire cell cycle.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 22397, 22398, 22399, 22400, 22401, 22402, 22403, 22404, 22405, 22406, 22407, 22408, 22409, 22410, 22411, 22412, 22413, 22414, 22415, 22793

13 HYDRO ENERGY

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 22419, 22428, 22432

22361 **(EPRI-EL—4658-SR, pp 7.1-7.6) Generator on-line diagnostics.** Kurtz, M. (Ontario Hydro, Toronto). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

In order to maximize reliability and useful operating life, and minimize maintenance costs, developing problems in machines must be detected at the earliest possible stage. On-line diagnostic monitoring for partial discharge, vibration, high temperature, core emissions, etc, can provide sensitive indications of abnormal conditions. Some typical monitoring systems used by Ontario Hydro are described.

14 SOLAR ENERGY

1403 Economics

REFER ALSO TO CITATION(S) 22697

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 22355, 22356, 22360, 22386, 22987, 23562

22362 **(AD-A—175910/9/XAB) Experimental test of minority-carrier annealing on gallium arsenide solar cells using forward-biased current. Master's thesis.** Clark, T.F. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1986. 86p. NTIS, PC A05/MF A01.

There has been recent interest in providing an on-orbit solar-cell annealing capability. Minority-carrier injection annealing was examined using a 0.5A/sq cm forward-biased current density on gallium arsenide solar cells in a 90°C ambient environment. The cells had been irradiated with 1-MeV electrons for a total fluence of 3El5el/sq cm. When annealing stopped, after 48 hours, the procedure had recovered 30% of the maximum power that was lost due to radiation damage. This procedure may have on-orbit potential.

22363 **(CONF-870523—1) Effect of the variation of the level of lactose conversion in an immobilized lactase reactor upon operating costs for the production of Baker's yeast from hydrolyzed permeate obtained from the ultrafiltration of cottage cheese whey.** Scott, T.C.; Hill, C.G. Jr.; Amundson, C.H. (Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA)). 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87005716.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

Operating costs for the production of Baker's yeast from hydrolyzed permeate from the ultrafiltration of cottage cheese whey were calculated as a function of the level of lactose conversion in the immobilized lactase reactor. These costs were calculated for the case of 90% conversion of lactose in the reactor and compared to those which result when running the reactor at lower conversions with recycle of unreacted lactose. Total operating costs were estimated by combining individual operating costs for the immobilized enzyme reactor, costs associated with processing a lactose recycle stream, and energy costs associated with cooling the reactor feed stream and sterilizing the hydroiysate stream. It was determined that operating costs are minimized at about 9.9 cents per pound of lactose when the reactor is run at approximately 72% conversion. This represents a savings of 2.4 cents per pound of lactose over the case of a once-through 90% conversion of lactose in the reactor. 8 refs., 4 figs., 9 tabs.

22364 **(DOE/CE/15270—T1) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, 8/20/86-3/31/87.** Garrett, H.E. (Missouri Univ., Columbia (USA)). 1987. Contract FG01-86CE15270. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006451.

Shortleaf pine seedings were inoculated with Pisolithus tinctorius had extensive ectomycorrhizal development throughout the root system. Fructose, glucose, sucrose, pinitol, and myoinositol were extracted and quantitated from roots. Sucrose accounted for about one-third of the total sugar content. In general, mycorrhizal roots contained significantly higher concentrations of total carbohydrates than nonmycorrhizal roots. Amont individual sugars identified, the concentrations of pinitol, fructose, glucose and sucrose were especially affected by ectomycorrhizal development and/or boron(B) fertilization. Mycorrhizal root systems contained greater concentrations of fructose than nonmycorrhizal root systems irrespective of method of B fertilization. Similarly, pinitol, glucose, and sucrose were typically more prevalent in mycorrhizal root systems although exceptions were found. Within mycorrhizal treatments, significant interactions were observed between method of B application and the concentration of individual sugars. In mycorrhizal plants, foliar + soil and soil application treatments yielded the greatest increases in individual sugars. Individual sugars in nonmycorrhizal roots were affected less by B fertilization than in mycorrhizal roots. Significant increases were, however, observed in fructose with either foliar + soil or soil-applied B, in glucose with foliar-applied B, and in sucrose with soil-applied B. 23 refs., 1 fig., 1 tab.

22365 **(DOE/ER/12030—1) Defined media for plant tissue culture: Final report.** Good, N.E. (Michigan State Univ., East Lansing (USA)). [1986]. Contract AC02-82ER12030. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006413.

This grant was for the purpose of developing improved plant tissue culture media. The rationale was to introduce the use of low pKa hydrogen ion buffers to stabilize pH and to introduce the use of slow release forms of the plant hormones, auxin and cytokinin, to provide the tissues with a constant supply of these essential factors. The zwittionic buffer, MES, proved useful for pH stabilization, while a wide range of indoleacetylamino acids provided a wide range of levels of available amino acids with consequent different levels of development of shoots, roots or callus. In general, some free indoleacetic acid in addition to the conjugate seemed necessary for organogenesis, but this phenomenon depended very much on the level of cytokinin. Time did not permit us to make any significant progress in the development of slow-release forms of cytokinins. 2 figs.

22366 **(DOE/ER/13356—T1) Physiological genetics of denitrification: A route to conserving fixed nitrogen: Progress [report], January 1986-January 1987.** Ingraham, J.L. (California Univ., San Diego, La Jolla (USA)). Jan 1987. Contract FG03-85ER13356. 7p. NTIS MF A01; 2; GPO Dep. File Number DE87006426.

A set of 35 mutant strains of Pseudomonas stutzeri blocked in the final step of the denitrification pathway, have been analyzed. These strains, isolated following treatment with a frame-shift mutagen grow anaerobically at near normal rates when nitrate or nitrite ions are present as the only reductant but fail to grow, or grow poorly, if N_2O is the only reductant. Analyzing these strains using two dimensional gels to examine the proteins they produce revealed that the strains can be grouped into classes that do not produce protein a (a^-b^+); those that do not produce protein b (a^+b^-) or produce neither protein a nor b (a^-b^-); and those that do not produce protein a but instead produce a new protein, e, that migrates to a position on the gel slightly above and to the right of protein b. Protein b has been identified as the copper-containing N_2O reductase described by Zumft. Protein a, which our mutant studies have identified and shown also to be essential for the reduction of N_2O, is membrane-bound. Like N_2O reductase, protein a also contains copper. As judged by the intensity of spots on two dimensional gels we found that the amount of protein a produced by cells grown anaerobically in complex medium in the presence of N_2O increases with the amount of copper in the medium. The protein seems to be copper-inducible. 1 fig., 1 tab.

22367 **(DOE/JPL—7005806) Development of high-efficiency solar cells on silicon web: Final progress report for the period April 1, 1984 to September 30, 1986.** Meier, D.L.; Greggi, J.; Hwang, J.W.; O'Keeffe, T.W.; Rohatgi, A.; Schmidt, D.N.; Rai-Choudhury, P. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 6 Oct 1986. Contract NAS-7-100-956786. 170p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87005806.

The major objective of the work reported was to improve web base material with a goal of obtaining solar cell efficiencies in excess of 18% (AM1). Efforts were directed toward identifying carrier loss mechanisms in web silicon, eliminating or reducing these mechanisms, designing a high-efficiency cell structure with the aid of numerical models, and fabricating high-efficiency web solar cells. The defect which is primarily responsible for limiting the minority carrier diffusion length in dendritic web silicon solar cells was identified as a dislocation decorated with impurity precipitates. Low-energy hydrogen ion implantation was used to passi-

vate the dislocation/precipitate defect in web silicon cells. Cells were fabricated from dendritic web silicon with oxide surface passivation, aluminum back reflector, and double-layer antireflective coating. The highest efficiency obtained was 16.6%. (LEW)

22368 (INIS-mf—10578, pp P269) **Versatile assay for total cellulase activity using radiolabelled bacterial cellulose.** Du Preez, P.; Kistner, A. 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

22369 **(ORNL/M—308) Short Rotation Woody Crops Program: Project summaries.** (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87007698.

This document is a compilation of summaries describing research efforts in the US Department of Energy's Short Rotation Woody Crops Program (SRWCP). The SRWCP is sponsored by DOE's Biofuels and Municipal Waste Technology Division and is field-managed at Oak Ridge National Laboratory. The SRWCP is an integrated basic research program with 18 field research projects throughout the United States. The overall objective of the program is to improve the productivity and increase the cost efficiency of growing and harvesting woody trees and shrubs. In a competitive technical review, 25 projects were chosen to form a new research program. Although some of the original projects have ended and new ones have begun, many of the long-term research projects still form the core of the SRWCP. This document contains individual summaries of each of the 18 research projects in the SRWCP from October 1985 to October 1986. Each summary provides the following information: name and address of the contracting institution, principal investigator, project title, current subcontract or grant number, period of performance, and annual funding through fiscal year 1986. In addition, each summary contains a brief description of the project rationale, objective, approach, status, and future efforts. A list of publications that have resulted from DOE-sponsored research follows many of the summaries.

22370 **(PB—87-153938/XAB) Biological gasification of renewable resources. Final report, March 1984-December 1985.** Fannin, K.F.; Srivastava, V.J.; Chynoweth, D.P.; Jerger, D.E.; Conrad, J.R. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1986. 169p. NTIS, PC A08/MF A01.

The objective of the project was to determine the best reactor configuration and optimum operating conditions for anaerobic digestion of each of four prototype feeds - water hyacinth solids/sludge, kelp, sorghum, and poplar - representing feedstocks of varying lignin content. A kinetic analysis of two different reactor types recovering a blend of water hyacinth and sludge indicated better performance of a non-mixed upflow solids reactor (USR) to that of a continuously stirred tank reactor (CSTR). The results of preliminary lab analyses and systems calculations suggest that substantial improvement in performance is possible by digestion of low-solids juice in an ambient temperature reactor and hyacinth solids in a different reactor. A kinetic analysis of kelp digestion also indicated superior performance of the USR over the CSTR digester. Conversion yields and rates and process stability were shown to be greater in a kelp lot with higher mannitol content. Preliminary results suggest that a two-phase leachate-bed recycle system may be most effective for biogasification of wood.

22371 **(SAND—86-7049) Development of a holographic beamsplitter for use with a conventional Fresnel lens.** (Hughes Aircraft Co., El Segundo, CA (USA). Display Systems Lab.; Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006770.

The object of this program was to develop a holographic beamsplitter module designed to be used with Si/1.72 eV AlGaAs cell pairs to achieve enhanced solar efficiencies. The hologram plate, when laminated to a Fresnel lens, was intended to focus <1.72 eV radiation onto the Si cell and >1.72 eV radiation onto the AlGaAs cell. The baseline concept for the holographic beamsplitter consisted of two singly exposed volume phase holograms laminated together. Analysis revealed that an ideal beamsplitter would yield 21.1% solar efficiency for series-connected cells. However, it was discovered that the optimum holographic beamsplitter theoretically yielded only 15.6% efficiency for series-connected cells, compared to 16.6% efficiency for a single Si cell. The limited performance was primarily due to the unavoidable rolloff of hologram response with wavelength inherent in singly exposed holograms. Independently connecting the cells and optimizing the AlGaAs band gap were not expected to yield significant improvement in solar efficiency. These results were corroborated by a 1985 West German study, which suggested that flattening the hologram response spectrum by double exposure might yield substantial improvements in solar efficiency. Results of a theoretical study to determine the performance using double-exposed beamsplitters were inconclusive. In any case, their added complexity would result in reduced yield and added production costs. In conclusion, the current holographic technology is not capable of providing a beamsplitter that will significantly improve the solar collection efficiency in Si/AlGaAs systems.

22372 **Population genetics of microalgae.** Gallagher, J.C. (Solar Energy Research Inst., Golden, CO, USA). pp 6-14 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

Intraspecific variation has been documented for virtually every major taxonomic group of microalgae. The presence of genetically distinct populations within species is probably a major factor determining the relative abundance of these species in different environments. Populations have been differentiated on the basis of the frequencies of biochemical markers as well as physiological parameters such as growth rates, temperature and salinity tolerances, photosynthetic characteristics, life cycle parameters and resistance to pollutants. The magnitude of genetically determined physiological variation among populations is often as large as that found among species. The presence of naturally occurring variants within species is important to algal biomass production because arbitrary decisions on the choice of strains to be used in pilot projects can have a drastic effect on the outcomes of these projects. Furthermore, it may be possible to selectively breed different strains for economically valuable characteristics.

22373 **Feasibility of mariculture of the brown seaweed, Sargassum muticum (Phaeophyta): Growth and culture conditions, alginic acid content and conversion to methane.** Gellenbeck, K.W.; Chapman, D.J. (Solar Energy Research Inst., Golden, CO, USA). pp 107-115 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

The macroscopic brown seaweed Sargassum muticum has been investigated as a candidate for semi-closed mariculture. Fifty liter chambers were used to determine yield (55 g fresh wt/m/sup 2//day), optimal stocking density (4 kg/m/sup 2/), the effect of added nutrients in the form of secondarily treated sewage effluent water and the reproductive characteristics of free-floating S. muticum. Alginic acid content of 12-21% dry weight was obtained from both cultured and natural populations. The effects of seasonal variation and nutrient regime on the content of alginic acid and mannitol are described. The biomass has also been tested for conversion to combustible methane gas through anaerobic digestion. Low technology, bench scale digesters were operated in a semi-continuous mode at 10-30 day hydraulic retention times and 0.96 and 1.92 kg VSS/m/sup 3/ digester/day loading rates. Gas production rates were in the range of 0.02-0.18 m/sup 3/CH/sub 4//kg VSS added.

22374 **Stability of carrageenan during anaerobic digestion.** King, G.M.; Guist, G.G.; Lauterbach, G.E. (Solar Energy Research Inst., Golden, CO, USA). pp 116-123 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

The stability of the sulfated polysaccharide carrageenan during anaerobic digestion was investigated using the red seaweed, Eucheuma cottonii. During the course of a 10 wk batch incubation, approximately 60% of the added E. cottonii biomass was fermented to CO/sub 2/, methane and volatile fatty acids (predominantly acetate). Carrageenan decomposition paralleled the loss of total biomass indicating no preferential degradation or preservation. The %C and %N content of the particulate material in the fermenters increased over time, presumably due to microbial growth. In contrast, %S decreased steadily due to the degradation of carrageenan. At the end of a 10 wk incubation, the carrageenan content of the remaining biomass was 51% compared to 61% in the original E. cottonii. In addition, carrageenan recovered after 10 wk digestion had a lower molecular weight and formed solutions with considerably reduced viscosities compared to undigested carrageenan. Hydrolysis of large quantities of sulfate (60 mmol/L) from carrageenan resulted in the formation of high dissolved sulfide concentrations which may have inhibited methane production due to sulfide toxicity; yields of methane from E. cottonii were much lower than have been reported for macroalgae with a lower sulfur content. Results from this study suggest that it is impractical to process E. cottonii simultaneously for hydrocolloids and methane.

22375 **Research on Porphyra aquaculture.** Waaland, J.R.; Dickson, L.G.; Duffield, E.C.S.; Burzycki, G.M. (Solar Energy Research Inst., Golden, CO, USA). pp 124-131 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

One of the approaches to implementing nori aquaculture in the Pacific Northwest is to develop cultivation methods for use with native species of the red seaweed Porphyra. Of the seventeen native species of Porphyra in the Northwest, five (P. perforata, P. abbottae, P. torta, P. pseudolanceolata, P. nereocystis) have been identified as having the qualities which make high quality nori. Research at the University of Washington is concentrating on (1) establishing laboratory cultures of the conchocelis stages of potential cultivars of these species, (2) defining the environmental conditions under which quantities of conchospores suitable for net seeding can be obtained from such cultures, and (3) seeding test nets for use in field growth tests of these native Porphyra species. Suitable conchospore production has been obtained with several strains of P. torta and successful field growth trials have been initiated with P. torta. The progress of this research is reported in this paper.

22376 **Physiological and metabolic studies on a branched hydrocarbon-producing strain of Botryococcus braunii.** Wolf, F.R. (Solar Energy Research Inst., Golden, CO, USA). pp 160-170 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

The oil-producing colonial green alga Botryococcus braunii exists in at least two physiological forms which are principally distinguished on the basis of qualitative hydrocarbon content. 'Active state' colonies accumulate linear olefins, chiefly C/sub 27/, C/sub 29/, and C/sub 31/ dienes, which have been reported to constitute from 0.1-36% of the dry weight. In contrast, 'resting state' colonies produce unique branched olefins (C/sub n/H/sub 2n-10/, n=30-37) believed to be of isoprenoid origin, although this speculation awaits confirmation through definitive biosynthetic studies. This paper reports results obtained from a series of physiological and metabolic experiments conducted with a resting state strain. Some of the unexpected findings revealed in these studies suggest the need to further examine the growth and hydrocarbon-producing potential of this form of the alga.

22377 **Bioconversion of algal biomass to neutral solvents.** Nakas, J.P.; Schaedle, M.; Tanenbaum, S.W. (Solar Energy Research Inst., Golden, CO, USA). pp 171-175 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

Five species of the microalgae Dunaliella (D. tertiolecta, D. primolecta, D. parva, D. bardawil, and D. salina) were evaluated for glycerol accumulation, growth rate, cell density, and protein and chlorophyll content as a function of NaCl concentration. The three marine species (D. tertiolecta, D. parva, and D. primolecta) grew well over the entire range of NaCl concentrations tested (0.2-4 M). The halophilic species (D. salina and D. bardawil) were difficult to cultivate in 0.5 M NaCl or less. Growth rates for all species were generally depressed at 3 M NaCl or higher. Glycerol content per cell cricreased with NaCl concentration and was dependent on cell size. Final cell densities tended to be species specific with D. tertiolecta reaching 14 x 10/sup 6/ cells/mL and D. bardawil and D. salina never exceeding 2 x 10/sup 6/ cells/mL. The algae were harvested, subject to bacterial fermentations and evaluated for type and quantity of end products. Clostridium pasteurianum converted algal biomass containing 4% glycerol to 16 g of mixed solvents (n-butanol, 1,3-propanediol, and ethanol) per liter. Additionally, elective culture techniques produced a Bacillus sp. and a Klebsiella sp. capable of fermenting an algal-glycerol mixture solely to ethanol and 1,3-propanediol (trimethylene glycol), respectively.

22378 **Microalgae fuel economics.** Benemann, J.R.; Weissman, J.C.; Goebel, R.P.; Augenstein, D.C. (Solar Energy Research Inst., Golden, CO, USA). pp 176-191 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

An engineering-economic feasibility analysis was undertaken to determine the economics of microalgae fuel production, based on reasonable assumptions about system design, management, achievable productivity, and harvesting processes. The need for enriched CO/sub 2/ was a major capital and operating cost factor, and restricts the siting of such plants near CO/sub 2/ sources - power plants, refineries, ammonia plants and CO/sub 2/ reservoirs. Harvesting assumed spontaneous settling of microalgae ('bioflocculation') followed by centrifugation. Harvesting capital costs approximately equaled the capital costs of the remainder of the system. System outputs were projected at 75 metric tons/hectare/year (mt/ha/yr) with 30% lipid content. System operations were assumed not to require significant management inputs (e.g. pest control, seed production). Even with such favorable assumptions, production costs of about Dollar 350/mt (ash free dry weight basis) were projected. This was for a product in the form of a 12-15% slurry, requiring further, and immediate, processing to fuels.

22379 **Bioflocculation of microalgae in mass cultures.** Lincoln, E.P.; Koopman, B. (Solar Energy Research Inst., Golden, CO, USA). pp 207-211 of Algal biomass technologies: An interdisciplinary perspective. Proceedings. Barclay, W.R.; McIntosh, R.P. Berlin, Germany, F.R.; Cramer (1986). (CONF-8404325—).

From Workshop on the present status and future directions for biotechnologies based on algal biomass production; Boulder, CO, USA (5 Apr 1984).

Bioflocculation promises to be an effective, low-cost means for initial concentration of algal cells from mass culture systems. An important factor in the induction of bioflocculation of microalgae grown wastewater medium was found to be continuous-flow mixing. Previous reports of bioflocculation in mass algal cultures by this method have been limited to systems using domestic

wastewater. Here we report on the bioflocculation of mass cultures of Micractinium Fresenius and Synechocystis Sauvageau grown on swine waste medium.

1406 Photovoltaic Power Systems

22380 (DOE/AL/38869—1) Establishment of a photovoltaic laboratory at the University of Lowell: Technical progress report. Costello, T. (Lowell Univ., MA (USA)). 30 Jan 1987. Contract FG04-86AL38869. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006410.

The tasks of moving equipment, installing photovoltaic arrays, and configuring laboratories are reported. Other activities discussed include defining projects to investigate water pumps and refrigerators, scoping the potential of grain drying to determine the largest potential market and impact. A design tool computer program was obtained and used. Course design activities for teaching photovoltaics are also reported. (LEW)

22381 (SAND—86-7039) Reliability of intermediate sized photovoltaic systems. (New Mexico Solar Energy Inst., Las Cruces (USA); Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006328.

An investigation of the reliability of installed intermediate sized photovoltaic systems identifies interconnection and corrosion losses as the most significant problems. This was determined by performing ten systematic field evaluations on eight different systems using consistent test techniques and recording methods. Simple computer programs were also developed to (1) normalize I-V field data, (2) determine array ratings, (3) predict failure rates and effects, (4) demonstrate the impact of maintenance, and (5) store the data base for future comparison studies. This investigation provides credible field test data on PV components reliability and failure rates.

22382 (SAND—87-0058C) Photovoltaic system technology. Jones, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-870416—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005069.

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

The level of photovoltaic system technology maturity is described by discussing four main aspects: simplicity of the photovoltaic system design process; acceptable balance-of-system costs; system reliability in field operating environments, and utility compatibility. (LEW)

22383 (SAND—87-7003) Central station photovoltaic array-field designs and design practices. Noel, G.T.; Smith, R.W. (Battelle Columbus Div., OH (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 335p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87007358.

This report reviews and critiques the designs of large (1 MW or greater) photovoltaic power systems operating in a utility generating station mode. Four existing installations and eight paper design studies are reviewed. In addition, subsystem-specific studies on grounding and fault protection, lightning protection, array field electrical circuit design, bypass diodes, power conditioning, and utility interfaces were reviewed. Detailed tabular summaries of system design features and characteristics are presented. Based on a critique of the designs and discussions with designers, installers, and operators, recommendations of design practices for future installations are made.

1407 Solar Thermal Power Systems

22384 (SAND—86-7040) Experimental studies of a closed-loop sulfur oxide energy conversion and transport system. McCrary, J.H.; McCrary, G.E. (New Mexico State Univ., Las Cruces (USA). Physical Science Lab.; Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 119p. NTIS, PC A06. File Number DE87007017.

The specific tasks performed are as follows: design and assemble a scaled-up, closed-loop energy conversion, transport and delivery system based on the SO_2/SO_3 chemical reaction system; conduct analytical studies needed for the design of solar thermochemical cavity receivers; perform an engineering design of a cavity receiver/dissociator suitable for testing at a 25 kW solar furnace; and design experimental tests that can be performed on the transport system from Section 1 that would address problem areas associated with the receiver engineering design.

1409 Solar Thermal Utilization

22385 (NMRDI—2-75-PSTS) New Mexico passive solar home temperature survey: Final report. Whittier, J. (New Mexico State Univ., Las Cruces (USA). New Mexico Solar Energy Inst.). Mar 1987. 135p. NTIS, PC A07/MF A01 - NMRDI, 457 Washington SE, Suite M, Albuquerque, NM 87108. File Number DE87900545.

This report presents the results of indoor temperature and energy consumption monitoring of thirty passive solar homes in New Mexico. Many different design styles are included in most of the various climate zones of New Mexico. In addition to the presentation of recorded or collected data, computer simulations were performed on each building. The computer simulations allow one to make additional comparisons between the different buildings. The results of the program confirm that passive solar homes are comfortable structures with low auxiliary energy requirements.

22386 (PB—87-134094/XAB) Final solar systems monitoring report, 1985. (Ontario Ministry of Energy, Toronto (Canada)). 1985. 208p. NTIS, PC PC E08/MF E01.

The Active Solar Monitoring Project was conducted by the Ministry of Energy of the Province of Ontario, Canada, between November, 1982, and October, 1985. The objective of the project was to instrument, monitor, assess, and report on the energy performance and reliability of the solar energy demonstration projects sponsored by the Ministry. The monitoring project was an essential part of Ontario's Solar Energy Program, which included over 190 solar heating demonstration projects, and 2 photovoltaic demonstration projects. These were located on government buildings, and on commercial, industrial, municipal, institutional, and religious buildings.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 22394

1502 Geology And Hydrology Of Geothermal Systems

22387 (DOE/ET/27111—T8) Structural styles of the Wilcox and Frio growth-fault trends in Texas: Constraints on geopressured reservoirs. Ewing, T.E. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1986. Contract AC08-79ET27111. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006471.

The wide variability in structural styles within the growth-faulted, geopressured trends of the Texas Gulf Coast is illustrated by detailed structural maps of selected areas of the Wilcox and Frio growth-fault trends and quantified by statistical analysis of fault compartment geometries. Structural variability is a key determinant of the size of geopressured aquifers in the deep subsurface. Two

major structural styles exist in the Wilcox trend. (1) In southeast and Central Texas, the trend consists of continuous, closely spaced faults that have little associated rollover despite moderate expansion of section; the fault plane flattens little with depth. (2) By contrast, in South Texas a narrow band of growth faults having high expansion and moderate rollover lies above and downdip of a ridge of deformed, overpressured shale but updip of a deep basin formed by withdrawal of overpressured shale. Frio fault systems generally display greater rollover and wider spacing than do Wilcox fault systems; however, the Frio trend displays distinctive features in each study area. Most of the Frio growth faults, however, have a similar geometry, showing substantial rollover, expansion of section, and a moderate flattening of the fault zone with depth, possibly related to a deep decollement surface. The local variability in style is related to the magnitude of Frio sedimentation and progradation and to the presence of thick salt or shale. Finding and developing a large geopressured aquifer require recognition of a favorable combination of sand-body geometry, reservoir quality, and fault compartment size and shape.

22388 **(LBL—22719) Modeling of thermodynamic and chemical changes in low-temperature geothermal systems.** Spencer, A.L. (California Univ., Berkeley (USA)). Dec 1986. Contract AC03-76SF00098. 156p. NTIS, PC A08. File Number DE87006930.

A method was developed to incorporate the transport of several chemical components into a model of the transport of fluid mass and heat within a geothermal system. It was demonstrated that the use of coupled hydrological, thermal and chemical data allows for the determination of field porosities, amounts and regions of cool recharge into the system as well as field permeabilities and the hot reservoir volume. With the additional information a reliable prediction of the long-term cooling rate can be made.

22389 **Geothermal mineralization. I. The mechanism of formation of the Beowawe, Nevada, Siliceous sinter deposit.** Rimstidt, J.D.; Cole, D.R. (Virginia Polytechnic Institute and State Univ., Blacksburg). *American Journal of Science;* **283**: 861-875(Oct 1983). Contract AC07-79ID12079;W-7405-ENG-26.

The siliceous sinter deposit at Beowawe, Nev., has a volume of 7.71×10^7 m^3 and contains 1.28×10^{11} kg silica. This silica precipitated from geothermal solutions that welled-up along the Malpais Fault, a graben bounding fault. Sinter formation involved three steps. (1) Geothermal solutions saturated with quartz in the reservoir moved to the surface where they cooled and became supersaturated with amorphous silica. (2) Amorphous silica particles nucleated (heterogeneously) to produce a colloidal suspension. (3) The amorphous silica particles agglomerated and were cemented together by amorphous silica precipitating in the embayments between the particles. At least 5.58×10^{14} kg of geothermal solution must have been produced over time to account for the mass of silica in the Beowawe Deposit. This fluid would have carried at least 4.95×10^{17} kJ of heat to the surface. 21 references, 6 figures, 1 table.

22390 **Local variations of seismic velocity in the Imperial Valley, California.** Jackson, D.D.; Lee, W.B. (Univ. of California, Los Angeles). *Bulletin of the Seismological Society of America;* **71**: No. 6, 1849-1861(Dec 1981). Contract AA03-76SF00034.

The authors inverted local earthquake arrival times to estimate spatial variations of seismic velocity. Their model consisted of near-surface station corrections and local perturbations to a standard crustal velocity model. The authors found a zone of relatively high-velocity trending southeast from the Salton Sea. This zone corresponds to the region of thickest sediments. The authors compared results with those of teleseismic studies by Savino et al (1977). The agreement was excellent, suggesting that the teleseismic delays are caused primarily by crustal velocity variations. Residual delays between the teleseismic observations and predicted crustal delays imply crustal thinning of 3 or 4 km along the axis of the valley. Known geothermal resource areas at Salton Sea (or Obsidian Buttes), Brawley, and East Mesa, lie on the axis of a zone of thin crust, and they may be intimately related to the Brawley fault. Neither local earthquake nor teleseismic arrival times can discriminate between these hypotheses, but the issue might be resolved by combining both types of data. Known geothermal resource areas at Heber, Dunes, and Glamis, lie away from the projected trace of the Brawley fault. These areas are nearly aseismic, and overlie crust with apparent seismic velocities only mildly higher than the regional average. These apparent velocity anomalies could be related to crustal thinning, but because of the very mild Bouguer gravity anomalies in these areas, it seems more likely that the velocity anomalies occur entirely within the crust. 7 references, 6 figures, 3 tables.

1503 Geothermal Exploration And Exploration Technology

22391 **(DOE/SF/15120—T1) Analyses of operational times and technical aspects of the Salton Sea scientific drilling project: [Final report].** (Well Production Testing, Carlsbad, CA (USA)). Dec 1986. Contract AC03-84SF15120. 93p. NTIS MF A01; 2; GPO Dep. File Number DE87006803.

The Deep Salton Sea Scientific Drilling Program (DSSSDP) was conducted in Imperial County of California at the Southeastern edge of the Salton Sea. Emphasis was on the acquisition of scientific data for the evaluation of the geological environment encountered during the drilling of the well. The scientific data acquisition activities consisted of coring, running of numerous downhole logs and tools in support of defining the geologic environment and conducting two full scale flow tests primarily to obtain pristine fluid samples. In addition, drill cuttings, gases and drilling fluid chemistry measurements were obtained from the drilling fluid returns concurrent with drilling and coring operations. The well was drilled to 10,564 feet. This report describes the field portions of the project and presents an analysis of the time spent on the various activities associated with the normal drilling operations, scientific data gathering operations and the three major downhole problem activities - lost circulation, directional control and fishing.

22392 **(LA—10923-OBES) Hydrogeochemical data for thermal and nonthermal waters and gases of the Valles Caldera- southern Jemez Mountains region, New Mexico.** Shevenell, L.; Goff, F.; Vuataz, F.; Trujillo, P.E. Jr.; Counce, D.; Janik, C.J.; Evans, W. . (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007722.

This report presents field, chemical, gas, and isotopic data for thermal and nonthermal waters of the southern Jemez Mountains, New Mexico. This region includes all thermal and mineral waters associated with Valles Caldera and many of those located near the Nacimiento Uplift, north of San Ysidro. Waters of the region can be categorized into five general types: (1) surface and near-surface meteoric waters; (2) acid-sulfate waters at Sulphur Springs (Valles Caldera); (3) thermal meteoric waters in the ring fracture zone (Valles Caldera); (4) deep geothermal waters of the Baca geothermal field and derivative waters in the Soda Dam and Jemez Springs area (Valles Caldera); and (5) mineralized waters near San Ysidro. Some waters display chemical and isotopic characteristics intermediate between the types listed. Data in this report will help in interpreting the geothermal potential of the Jemez Mountains region and will provide background for investigating problems in hydrology, structural geology, hydrothermal alterations, and hydrothermal solution chemistry.

22393 **(LA—10934-OBES) First CSDP [Continental Scientific Drilling Program]/thermal regimes core hole project at Valles Caldera, New Mexico (VC-1): Drilling report.** Rowley, J.; Hawkins, W.; Gardner, J. (comps.). (Los Alamos National Lab., NM (USA)). Feb 1987. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007723.

This report is a review and summary of the core drilling operations of the first Valles Caldera research borehole (VC-1) under the Thermal Regimes element of the Continental Scientific Drilling Program (CSDP). The project is a portion of a broader program that seeks to answer fundamental scientific questions about magma,

rock/water interactions, and volcanology through shallow (<1-km) core holes at Long Valley, California; Salton Sea, California; and the Valles Caldera, New Mexico. The report emphasizes coring operations with reference to the stratigraphy of the core hole, core quality description, core rig specifications, and performance. It is intended to guide future research on the core and in the borehole, as well as have applications to other areas and scientific problems in the Valles Caldera. The primary objectives of this Valles Caldera coring effort were (1) to study the hydrogeochemistry of a subsurface geothermal outflow zone of the caldera near the source of convective upflow, (2) to obtain structural and stratigraphic information from intracaldera rock formations in the southern ring-fracture zone, and (3) to obtain continuous core samples through the youngest volcanic unit in Valles Caldera, the Banco Bonito rhyolite (approximately 0.1 Ma). All objectives were met. The high percentage of core recovery and the excellent quality of the samples are especially notable. New field sample (core) handling and documentation procedures were successfully utilized. The procedures were designed to provide consistent field handling of the samples and logs obtained through the national CSDP.

1508 Geothermal Power Plants

22394 (EPRI-AP—5059-SR) Proceedings: Tenth annual geothermal conference and workshop. (Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 545p. (CONF-8606277—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920265.

From 10. annual geothermal conference and workshop; Portland, OR, USA (24 Jun 1986).

This volume contains the proceedings of the conference, the theme of which was "Expanding Geothermal Capacity with Modular Systems." Technical sessions included a review of the modular concept and existing modular systems; presentation of utility power plant and research projects; overview of the EPRI geothermal subprograms; discussion of new geothermal research programs; and update on international geothermal activity. A panel discussion presented varied perspectives on modular geothermal systems, and workshop sessions examined the market for experience with, and technical specifications for modular geothermal power plants. Separate abstracts have been prepared for individual presentations.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 22211

1520 Geothermal Data And Theory

22395 (JINR—R-6-85-874) Attempt to concentrate new natural spontaneously fissioning nuclide from geothermal brine of Cheleken Peninsula. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701447.

Submitted to the journal Sov. Radiochem. .

In order to concentrate a new not yet identified spontaneously fissioning nuclide (NSFN) discovered in geothermal brines of Cheleken Peninsula various heterogenic processes were used in the brine-solid phase systems (ionites, inorganic sorbents, metals, etc.). Besides, natural inorganic collectors selected on the borehole mouths were analysed. Concentrates with approx. 10/sup 5/ enrichment coefficient have been obtained. It is shown that NSFN has a low degree of coprecipitation with sulfides and metal hydroxydes. It is not reduced by neither iron, nor by aluminium, is sorbed on cationites and anionites. The results obtained allow one to draw a conclusion that NSFN is not an isotope of transuranium elements. NSFN is near by its chemical properties to gold and mercury. According to the experimental data, its standard electrode potential equals (1.3+-0.2) B. 31 refs.; 4 tabs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 22162, 22166, 22169, 22517, 22688

22396 (DOE/MC/21394—2199) Gas turbine component screening program: Final report. Wenglarz, A.; Ames, F.; Fox, R.; Wilkes, C.; Williams, J. (General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Operations). Dec 1986. Contract AC21-84MC21394. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001057.

Coal-water fuels (CWF) have been tested in a subscale rich-quench-lean (RQL) gas turbine combustor. The RQL combustion concept appears promising for producing acceptable environmental NO/sub x/ levels in future turbines operating with CWF. The RQL combustor was operated in this program at conditions representative of a recuperated locomotive turbine. Initial shakedown tests of the RQL combustor were followed by combustion/emissions tests and deposition, erosion, corrosion (DEC) tests using three CWF. For the DEC experiments, specimens were exposed in two test sections to the CWF combustion products. The gas and most specimen surface temperatures in the first and second test sections represented temperatures of the first stators and rotors, respectively, of the locomotive turbine. The material for many of these specimens was a turbine alloy (IN 738) covered with a coating (CoCrAlY) which has demonstrated corrosion and erosion resistance in coal-fired PFBC cascade tests. Overall combustion efficiencies up to 99.2% were achieved using only CWF with no supplemental fuels or pilot except at startup and shutdown. Based on combustion requirements alone, the highest measured combustion efficiencies approached those values necessary for commercial turbine systems. While substantial differences in combustion performance were observed for the test fuels, NO/sub x/ emissions performance differed little. NO/sub x/levels (at 15% O_2 and adjusted for humidity) typically ranged from 250 to 300 ppM. Deposition was observed on all specimens for all fuels and was the dominant short term degradation process. Deposition rates were highly sensitive to temperature. 18 refs., 37 figs., 10 tabs.

22397 (EPRI-CS—4900-SR, pp 1.1-1.19) Sumner County Solid Waste Energy Recovery Facility. McGowin, C.R. Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

In 1982, the Sumner County Resource Recovery Authority completed construction and startup of a 150 t/d refuse-fired cogeneration facility in Gallatin, Tennessee. The facility has two parallel 100 t/d capacity mass burn systems, each consisting of a water-cooled rotary combustor, boiler, ash removal system, and an electrostatically-assisted fabric filter. A privately-run materials separation facility also operates on site. Steam generated by the facility is sold to three nearby industrial customers, and electricity generated by a 550 kW back-pressure turbine generator is sold to the Tennessee Valley Authority. The key milestones, feasibility studies, design, and actual construction cost of the facility, the initial operating experience, and field performance and emissions tests performed by the Tennessee Valley Authority during 1982 and 1983 are summarized. Construction of the facility began in 1980 and was completed in 1982. The final cost of the facility increased to more than $14 million from the initial 1977 estimate of $5.2 million. During 1982, the facility operated at approximately 60% of capacity, consumed 39,000 tons of municipal solid waste (MSW), and generated 250 million pounds of steam and 1.6 million kWh of electricity. The electrostatically-assisted baghouse and ash removal systems caused significant operating problems, including high pressure drop and burn holes in the filter bags and jamming of the drag chains. Mechanical collectors were added ahead of the baghouses, and the baghouses have since been replaced by electrostatic precipitators. The scope of the performance and emissions tests conducted in 1982 and 1983 included volume and weight reduction of refuse,

combustion and boiler efficiency, fly ash and bottom ash sampling and analysis, and solid waste, stack, and water effluent analysis.

22398 (EPRI-CS—4900-SR, pp 2.1-2.5) **Westchester County Resource Recovery Program.** Weber, C.E. (Dept. of Public Works, White Plains, NY). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Westchester County, like many areas of the US, faced the growing problem of developing and implementing a system to manage and dispose of mounting quantities of solid waste. The Solid Waste Resource Recovery Facility at Charles Point in Peekskill, together with other facilities for transfer of solid waste, are the culmination of more than ten years of concentrated planning and preparation including engineering studies, land acquisition, financial planning, municipal agreements, and construction as part of a Regional Solid Waste Management Plan. An initial plant of 1400 tons per day capacity was proposed to be constructed at this site which is known as the Grasslands Reservation. Numerous public meetings on the proposal attracted hundreds of vocal opponents which resulted in the Board of Legislators not authorizing the implementation of the recommended plan on that site. Earlier attempts to site a Resource Recovery Facility at other locations were also unsuccessful. In 1979, the City of Peekskill, located in the northwesterly corner of the County, approached the County government with a proposal that should the County and the City agree on certain preconditions, the City might have a site that would be suitable for a resource recovery plant. The site was a large industrial area on what is known as Charles Point and which had earlier housed a single industrial facility. The company closed virtually all of its facilities and razed the buildings, leaving the site vacant and available. The planning and financing of the facility are described.

22399 (EPRI-CS—4900-SR, pp 3.1-3.19) **Mass burning technology operating experience at Signal Environmental Systems.** Hepp, M.P. (Signal Environmental System, Inc., Hampton, NH). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

A summary of the design and operating experience of Signal Environmental Systems (SES) using mass burning technology to convert refuse into energy is presented. A general overview of those process areas which are unique to refuse-fired power plants is presented, and some of the more notable design improvements in the plants are reviewed. Finally, a summary of plant performance and operating experience is presented.

22400 (EPRI-CS—4900-SR, pp 4.1-4.8) **Trash to electricity: an environmental plus.** Bell, H.A. (Div. of Electricity, Columbus, OH). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

The Columbus Refuse and Coal-Fired Municipal Electric Plant is unique in its ability to burn refuse and coal at the same time. In the early 1970's, the US Environmental Protection Agency (EPA) was threatening to close the city's landfill and its Municipal Light Plant as well. The landfill was too close to the Scioto River and nearing capacity. The century old light plant was burning high-sulfur Ohio coal and operating out of compliance with USEPA standards. The Battelle Memorial Institute, with a grant from the EPA, experimented with burning a coal-refuse mix by using a makeshift conveyor belt which dumped into the utility boiler at the old power plant. The study was extended and so was the life of the plant. The experiment proved successful enough to convince city council to use $250,000 in federal revenue sharing funds to commission a formal feasibility report on a refuse-coal fired facility. The results of the study are presented.

22401 (EPRI-CS—4900-SR, pp 5.1-5.18) **Mid-Connecticut Refuse to Energy Project: Hartford, Connecticut.** Thomas, R.H. (Northeast Utilities Service Co., Hartford, CT). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Since 1976, Northeast Utilities has worked with the Connecticut Resources Recovery Authority to develop a refuse-to-energy facility at South Meadow Station in Hartford, Connecticut. The first of the station's eight original boiler units was constructed in 1921 with the final unit in 1949. In 1976, the boilers and turbines were retired and scrapped with the exception of the two most recent turbine generators (1942 and 1949) which were retired in place for use in this project. The project site facilities will consist of a 2000 ton per day Waste Processing Facility, a Power Block Facility, and an Electric Generating Facility. The Waste Processing Facility will be separate from the existing site structures and will utilize Combustion Engineering's (CE) RDF process. The Power Block Facility will generate steam from the RDF and coal, utilizing three CE VU-40 waste fuel boilers each with a spray dry lime scrubber and baghouse. Most of the boiler equipment will be contained in the same building as the original boilers. A more detailed technical description of the Mid Connecticut Project and history of its development are presented. Problem areas concerning both the technical design and the various development phases are highlighted. In addition, foreseen operating and maintenance concerns are reviewed.

22402 (EPRI-CS—4900-SR, pp 6.1-6.16) **Regional approach to processing and combustion of municipal solid waste.** Raatikka, L.M. (Northern States Power Co., Minneapolis, MN). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

In several states recent legislation has been promulgated which limits or prohibits disposal of municipal solid waste (MSW) in landfills. An alternative to landfilling MSW which has been developed only in the past decade in the US is combustion of these wastes in either mass burn incinerators or boilers designed to burn refuse derived fuel (RDF). Northern States Power Company (NSP) believes the utility industry is capable of handling and incinerating processed MSW in the form of RDF. Although combustion experience of RDF by other industries is limited, much has been learned regarding the difficulty of handling and burning RDF during the past few years. NSP has recently began construction of a 1000 tons per day (TPD) RDF processing plant in Newport, Minnesota and conversion of four spreader stoker boilers at two of its plants in Red Wing and Mankato, Minnesota for RDF firing. NSP recognizes that RDF is a difficult fuel to handle and fire in utility boilers. However, NSP is confident that it can resolve any problems which may arise from the use of RDF. This confidence, in part, is based upon an extensive testing program involving dedicated firing of 1000 tons of RDF in Red Wing No. 1 Boiler during the past two years. Strategic location of small power plants near population centers in the 1940's and 50's provides a good base for regional processing and combustion of waste.

22403 (EPRI-CS—4900-SR, pp 7.1-7.4) **Burning refuse derived fuel at Blount Station of Madison Gas and Electric Company.** Barlow, K.M. (Madison Gas and Electric Co., WI). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Some of the problems experienced by the City of Madison, Wisconsin in operating a waste-to-energy facility are discussed. The operation has never been profitable because it has never been possible to burn 20,000 tons of RDF per year as was originally planned.

22404 (EPRI-CS—4900-SR, pp 8.1-8.8.12) **Refuse derived fuel and coal: the Lakeland experience.** Garing, C.D. (McIntosh Power Plant, Lakeland, FL). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

The City of Lakeland, Florida, Department of Electric and Water Utilities owns and operates a municipal electric utility system to generate and distribute electric power. The Utility serves over 60,000 electric customers in a 260 square mile service area. It is one of the pioneers of burning municipal solid waste (MSW) as a supplemental fuel in a large electric utility boiler. In the mid-seventies, Lakeland projected a need for more power to meet the electric demand of a growing population. A 364 megawatt steam turbine generating unit was designed to fire eastern bituminous coal and a combination of pulverized coal and 10% processed Refuse Derived Fuel (RDF) from MSW. An electrostatic precipitator removes the stack gas particulates, and flue gas desulfurization system removes sulfur dioxide while burning coal. The solid waste processing facility, the RDF handling equipment, the problems encountered during the second year of operation, and the economics of burning RDF in a large electric utility boiler are described.

22405 (EPRI-CS—4900-SR, pp 9.1-9.8) **Cofiring of RDF and coal in a cyclone utility boiler: an industry update.** Gunzelman, C.P. (Baltimore Gas and Electric Co., MD). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Baltimore Gas and Electric Company (BG & E) has joined with Maryland Environmental Service (MES) and Baltimore County, Maryland to help solve a portion of Central Maryland's solid waste disposal problem. A long term test burn of Refuse Derived Fuel (RDF) at BG & E's C.P. Crane generating station has been started. The RDF is produced at the Baltimore County Resource Recovery Facility in Cockeysville, MD. At this facility, residential municipal solid waste is collected and processed to remove ferrous metals, glass and other incombustibles. What is left after processing is RDF - a light combustible material which resembles shredded paper - with a heating value of approximately 6000 BTU/lb. The RDF process not only produces a usable fuel, but drastically reduces the volume of waste that is landfilled thus extending landfill life. After production, the RDF is compressed into a tractor trailer for transport to the C.P. Crane station in eastern Baltimore County. The C.P. Crane facility consists of 2 - 200 MW coal fired units. Each unit is powered by a Babcock & Wilcox cyclone furnace, but the RDF is only burned in Unit 2. Upon receipt of the RDF, it is fluffed up and blown into each of Unit 2's four (4) cyclones. Up to 20% RDF on a BTU basis may be admitted to each Unit 2 cyclone. Combustion and heat release occur in the violent swirling conditions within each cyclone while flyash is collected in a baghouse and slag is tapped out the furnace bottom. The operation of the facility is described.

22406 (EPRI-CS—4900-SR, pp 10.1-10.8) **Ames waste-to-energy system: 1985 update.** Joensen, A.W. (Iowa State Univ., Ames). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Fluff RDF is now co-fired in the B & W 70 MW Unit No. 8 Thermal, and other operational performance is reviewed with special emphasis on boiler and ESP efficiency. Fuel furnace injection behavior and excess air requirements are also discussed. An update is provided on the process plant economic balance sheet which includes the drop in ferrous metals revenue.

22407 (EPRI-CS—4900-SR, pp 11.1-11.17) **Refuse derived fuel (RDF) burning experience at Potomac Electric Power Company's (PEPCO) Dickerson Unit 3.** Ulman, R.R. (Potomac Electric Power Co., Washington, DC). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

In February 1985, Potomac Electric Power Company (PEPCO) signed a four-party agreement with Montgomery County, Maryland Environmental Services (MES) and National Ecology Incorporated (NEI). The agreement called for the parties to conduct an RDF test burn at PEPCO's Dickerson Unit 3. NEI operates on RDF processing facility in Cockeysville, Maryland which produces RDF for Baltimore Gas & Electric's Crane Station, and produced RDF for the test at Dickerson. The testing was to be performed in four phases. Phase I consisted of baseline data collection, Phase II of obtaining the maximum RDF burn rate, Phase III of performing detailed emission and performance testing with RDF. Phase IV was to consist of burning RDF on a longer-term basis, as if it were a regular plant system. Phases I, II and III have been completed. At this point, Phase IV has been deferred. This is because additional boiler modifications (dump grate) and testing are necessary if RDF is to be burned on a permanent basis. Test burning was initially performed with the same grade of RDF that was processed for BG & E. When the fine material was burned, there was a substantial difference between the burn-out of this grade of RDF and the coarse grade. Emission and performance tests were conducted using both the fine and coarse grades of RDF. For both grades of RDF, the unit passed the particulate emission standards. The total effect of RDF on unit performance is not yet clear, as an analysis of the test data is not completed. At this point, it can be said that neither the coarse nor fine RDF can be burned on a permanent basis without modifications and additional testing to Dickerson Unit 3.

22408 (EPRI-CS—4900-SR, pp 12.1-12.23) **Guidelines for cofiring refuse-derived fuel in electric utility boilers.** Wolfs, K.E.; Ege, H.D.; Kimber, A.; Fiscus, D.E.; Joensen, A.W.; Savage, G.M.; McGowin, C.R. (Burns and McDonnell, Kansas City, MO). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Cofiring refuse-derived fuel (RDF) with coal or oil in a utility boiler is one of several commercial options for recovering energy from municipal solid waste (MSW). Other commercial options include mass burning of MSW in dedicated water-wall mass burning boilers, burning RDF in semi-suspension-fired or fluidized bed boilers, and recovery of methane gas from sanitary landfills. During the 12-year period 1972 through 1984, nine US utilities cofired 608,040 t of RDF with coal or oil in retrofitted and new utility boilers. Of these, only four were continuing to cofire RDF at the end of November 1985, the others having discontinued operations for a variety of reasons, mostly economic. In order to review utility experience and recommend design and operating guidelines, the Electric Power Research Institute (EPRI) and the US Department of Energy's Argonne National Laboratory (ANL) cosponsored the project, Guidelines for Cofiring Refuse-Derived Fuel in Utility Boilers. The project was conducted in two phases between 1982 and 1985. Phase I, sponsored by ANL, reviewed US utility RDF cofiring experience and identified problems and solutions applied by the utilities. Phase II, sponsored by EPRI, developed recommended RDF specifications and design and operating guidelines for RDF preparation and cofiring equipment and evaluated the impact of RDF cofiring on boiler performance and economics. The objective of this study was to develop guidelines for the design and operation of RDF cofiring and cofiring equipment for utility boilers.

22409 (EPRI-CS—4900-SR, pp 13.1-13.18) **RDFCOAL: RDF cofiring boiler performance model.** Fiscus, D.E.; Joensen, A.W.; McGowin, C.R. (Midwest Research Institute, Kansas City, MO). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

The RDFCOAL RDF Cofiring Boiler Performance Model was prepared to assist in the preparation of the RDF cofiring guidelines for utility boilers under the joint EPRI/US DOE-cosponsored project. The model estimates the impact of cofiring refuse-derived fuel RDF with coal or oil on utility boiler performance and operation.

22410 (EPRI-CS—4900-SR, pp 14.1-14.9) **Resource recovery air regulations and guidelines: New York State's experience.** Davis, J.G. (New York State Dept. of Environmental Conservation, Albany). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

New York State, like many other states across the nation, is being driven to deal with the complex issues associated with the burning of municipal refuse. Most states are handicapped by obsolete or nonexistent regulations. This, coupled with very limited new useful data on emissions and impacts makes review of these projects difficult. New York is no exception, but is one of the first states to undertake a comprehensive program to evaluate emissions and impacts from municipal refuse combustion while simultaneously tailoring requirements to protect public health and welfare. The dire consequences associated with continued landfilling practices will not wait for the last research project to be conducted before viable alternatives are found. For this reason New York is moving to develop regulations for municipal refuse combustion before all the answers are available. At the same time, research is being conducted to further knowledge in this area. New York's approach to solving these problems is discussed.

22411 (EPRI-CS—4900-SR, pp 15.1-15.17) **Standards and the control of trace emissions from refuse-fired facilities.** Velzy, C.O. (Charles R. Velzy Associates, Inc., Armonk, NY). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

In the recent past, development of standard methods for sampling and characterization of emissions from combustion processes, including refuse-fired facilities, has been driven primarily by regulators. They envisioned their need as being quantification of discharges to compare to a numerical discharge limit. If the actual emissions were too high, the plant was ordered to clean the plant discharge or shutdown. While some problems were experienced in this simplistic approach, it has generally resulted in adequate control of emissions, once standard sampling methodology was adopted. However, with recent rapid advances in analytical capability, chemicals have been discovered in refuse-fired facility effluents that are, in large enough quantities, quite toxic, This has created concern on the part of the public and has created a need for new standardized sampling and analytical methodology. There is also a need to modify the methods used by regulatory agencies in developing and adopting standard methods. Thus, development of a standard, or a guideline, if it is to be rigorous, reasonable and widely applicable must involve meaningful participation by all affected parties. Discussion, judgement and compromise are all necessary ingredients in reaching agreement on a document that best represents the total public interest. The development of standards and the control of emissions from refuse-fired facilities are discussed.

22412 (EPRI-CS—4900-SR, pp 16.1-16.14) **Monitoring the fate of chlorine from MSW sampling through combustion.** Domalski, E.S. (National Bureau of Standards, Gaithersburg, MD). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

The total chlorine and water soluble chlorine contents of the components of municipal solid waste (MSW) have been determined from sampling studies carried out at two sites, Baltimore County, MD, and Brooklyn, NY for a five-day period. The total chlorine contents of the MSW samples from Baltimore County, MD and Brooklyn, NY, are 0.45 and 0.89 mass %, respectively. Combustion measurements were carried out in a multi-kilogram capacity flow calorimeter on samples of cellulose, cellulose/sand, cellulose/sand/polyvinyl chloride in 100% oxygen and several oxygen/nitrogen mixtures. Measurements were carried out to study the conditions related to the formation/destruction of chlorinated organic compounds as combustion products. Qualitative identifications of a significant variety of chlorinated organic compounds have been made.

22413 (EPRI-CS—4900-SR, pp 17.1-17.21) **Considerations in developing a research program to establish criteria for operating MSW incinerators to minimize emissions of dioxin/furans.** Visalli, J.R. (New York State Energy Research and Development Authority, Albany). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Many States and the Federal government are in the process of developing air emission standards and plant design and operating guidelines for municipal solid waste (MSW) incinerators. Air pollutants of concern include acid gases, heavy metal particulate, and trace organic compounds such as dioxin and furan. The available data to assist in developing technically rigorous standards and guidelines, especially for dioxin and furan, are in most cases inadequate, misleading or non-comparable. Past problems with dioxin and furan data include: non-standard sampling and analytical methods, lack of associated plant operations and combustion quality information, different definitions of dioxin and furan with a focus on only the health-related components of these compounds, sampling of just stack emissions (i.e., after the air pollution control device), and reliance on just fly and bottom ash samples. The New York State Energy Research and Development Authority, in conjunction with a number of other organizations, is developing a research program to address the problems of formation, destruction and control of trace organic compounds during the combustion process. The program has laboratory, pilot and full-scale project components which are in various stages of planning and implementation. The theoretical and practical issues, limitations and trade-offs which have arisen during the planning and implementation of the full-scale plant testing component of the program are discussed. A brief summary of the status and costs of this programmatic component is also provided.

22414 (EPRI-CS—4900-SR, pp 18.1-18.32) **Trace metal, acid gas, and dioxin emissions data collected at refuse energy recovery facilities in the US, Japan, and Europe: testing methods, results, and emission factors.** Hahn, J.H. (Cooper Engineers, Inc., Richmond, CA). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Since the late 1970s, testing for trace metal, acid gas, and dioxin emissions from refuse energy recovery facilities and their associated air pollution control equipment has occurred usually as a result of the regulatory process. In many cases, only uncontrolled emission data could be collected, as air pollution control equipment being required for new, refuse-fired sources of air pollution were not in operation at existing plants in the US. In the 1982 to 1984 period, several testing programs collected data from refuse energy recovery facilities in Japan and Europe. The data on emissions have come from refuse-fired facilities with dry scrubbers in combination with electrostatic precipitators (ESP) and/or baghouses. However, a lack of uniform, internationally agreed upon, methods has produced air emissions data that are difficult to compare for use in local, and Federal, air quality permit applications. The data presented on heavy metal emissions begin with uncontrolled emissions from several refuse energy recovery facilities, and include total heavy metal emissions and heavy metal emissions by particle size. Special testing for Hg is also discussed. Test methods for controlled heavy metal emissions are outlined and data are presented from ESP and baghouse outlet testing; again, emissions of heavy metals

are given as total and by particle size. Uncontrolled acid gas emissions, including HCl, HF, SO_2 SO_3, and NH_3 are presented based on refuse fuel characteristics, refuse heat release rate, and type of refuse-fired energy recovery facility. Trends for the future are addressed.

22415 (EPRI-CS—4900-SR, pp 19.1-19.9) **Emissions control at a commercial solid waste-fired steam or power plant.** Kemp, C.C. (Canruf Co., Toronto, Ontario). Nov 1986. NTIS, PC A14/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number DE87003411. (CONF-8511251—).

From Municipal solid waste as a utility fuel; Madison, WI, USA (20 Nov 1985).

Controlling the emissions day in and day out from a commercially operated solid waste-fired steam or electric plant is discussed. Emissions control begins with the design of the facility and continues throughout its operating life. Emissions from these plants are carried away in watery effluents, in the solid residue (ash and flyash) from the plant, as noise and directly to the atmosphere. The watery effluents and noise emissions from plants fired with solid-waste are generally similar to those from plants fired with a fossil fuel. Thus, among the watery effluents are blowdowns from the boiler, the feedwater treatment system and the cooling system, all of which are indistinguishable from those from conventionally fired units. Regardless of the problems involved in controlling these emissions, it is possible to design and operate plants that meet pollution control requirements in the USA.

22416 **(EPRI-CS—5033) Corrosion-product transport in a cycling fossil plant: Final report.** Hook, T.A.; Pearl, W.L.; Sawochka, S.G. (NWT Corp., San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 121p. Research Reports Center Box 50490, Palo Alto, CA 94303. File Number TI87920278.

One of the major differences in plant corrosion experienced by a plant in normal operation and in on-off cyclic operation is the extent of potential exposure to oxygen. (1) Shutdown oxygen levels have a major effect on carbon steel corrosion and subsequently on the amount of iron transported to the boiler, while copper transport is affected to a lesser extent. (2) Condensate oxygen concentrations can reach 1 ppM during shutdowns even when condenser vacuum is maintained. Reducing operating air leakage rates can have a significant impact upon the peak concentration reached during shutdowns. The shell sides of the feedwater heaters also are a major source of increased shutdown air leakage. If steps are taken to eliminate these air inleakage pathways, the oxygen concentration in the condensate can be held below 100 ppB during shutdowns. (3) Over a typical 40-hour on-off cycle, the corrosion product input to the boiler can range from 0.5 to 5 pounds for iron and from 0.3 to 0.6 pounds for copper with the amount depending on the amount of corrosion products deposited within the condensate-feedwater system and on the steps taken to minimize the air intrusion during the preceding shutdown. (4) Control of the peak oxygen concentration in the condensate during shutdowns showed the most promise for reducing the corrosion product input to the boiler. (5) An oxygen removal system exploiting either an activated carbon catalyst or other inert catalysts to accelerate the hydrazine-oxygen reaction may be effective for controlling shutdown oxygen excursions. The effectiveness of such a system for controlling the peak oxygen concentration would depend upon the steps taken to minimize air inleakage. 9 refs., 46 figs., 14 tabs.

22417 **(EPRI-CS—5034) Evaluation of the PM burner: A low-NO/sub x/ pulverized-coal-firing system for tangentially fired utility boilers: Final report.** Tokuda, K.; Sakai, M.; Kaneko, S.; Kunimoto, T.; Kokkinos, A.; Donais, R.E. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan); Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 325p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920274.

A new low-NO/sub x/ firing system for tangentially-fired boilers, called the Pollution Minimum or PM firing system, was recently developed by Mitsubishi Heavy Industries (MHI) of Japan in response to that country's stringent NO/sub x/ emission regulations. The Electric Power Research Institute contracted with MHI and Combustion Engineering, Inc. to evaluate this technology for US coal-fired utility boiler applications. The evaluation consisted of (1) pilot-scale combustion tests with an 80 MBtu/h prototype PM firing system, and (2) an engineering and economic feasibility study of applying the PM system at new and retrofit US utility applications. The combustion test used four US coals representing a wide range of US coal properties and utility usage: (1) low-sulfur eastern bituminous; (2) high-sulfur midwestern bituminous; (3) high-nitrogen, low-sulfur western sub-bituminous; and (4) Texas lignite. The tests verified that NO/sub x/ emission levels in the 150 ppM range (corrected to 3% O_2) are achievable with all four coals using the PM firing system. These low NO/sub x/ emissions were achieved without adverse effects on carbon conversion, ignition stability, and overall combustion performance. The applicability of the PM firing system in tangentially-fired steam generators was examined for retrofit and new units through case studies based on actual designs for US steam generators. This examination revealed that the desired level of NO/sub x/ emissions will affect the complexity of the firing system modifications, especially for retrofit cases. For retrofit installations, this complexity was influenced by site-specific factors peculiar to each boiler. Guarantees of lower NO/sub x/ emissions near 150 ppM (0.2 lb/10^6 Btu) result in more elaborate systems and higher costs. 9 refs., 66 figs., 22 tabs.

22418 **(EPRI-CS—5069) Prevention, detection, and control of coal pulverizer fires and explosions: Final report.** Carini, R.C.; Hules, K.R. (Riley Stoker Corp., Worcester, MA (USA) ; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 270p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920271.

The utility industry continues to be plagued by fires and explosions in the pulverizer systems of coal fired power plants. With the increased use of low rank reactive coals these events are cause for growing concern. The objectives of the project included an assessment of current fire, explosion, extinguishing, inerting, and detecting experiences in US power plants. A survey of 361 US power plants determined the historical trends and event occurrences in the industry. The survey analysis isolated plant characteristics that define high and low risk. Bench and full scale laboratory experiments were conducted to study the origin and dynamics of fires and explosions in pulverized coal systems. Fires within mills and classifiers, but not those located in coal pipes, were found to be the triggers for pressure events that could exceed 1000 psig. The influence of system geometry, coal characteristics and coal dust concentration in explosion origin and growth were determined. Additional goals included experimental investigation of effective fire detection and extinguishing, and explosion inerting. The benefits and hazards of detection, extinguishing, and inerting systems are discussed and evaluated. In addition, the direction and methods for future research to meet the ultimate goal of explosion free pulverizer systems is presented. 124 figs., 44 tabs.

22419 (EPRI-EL—4658-SR, pp 1.1-1.8) **Generator reliability: a utility perspective EEI Electrical System & Equipment Committee.** Yule, L.R. (Commonwealth Edison, Chicago, IL). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The results of a survey on electric generator reliability are presented. The information was obtained by means of a questionnaire sent to electric utilities. The questions were formulated in order to obtain a consensus on how investor-owned electric utilities feel electric generator reliability is faring and to broadly define suggested areas for future research. Suggested areas for future research are given for both hydro- and stream-driven generators.

22420 (EPRI-EL—4658-SR, pp 2.1-2.11) **GADS - generator availability trends.** Niebo, R.J. (North American Electric Reliability Council, Princeton, NJ). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The overall availability of any generating unit is dependent upon the reliability of the individual components. While component redundancy can improve unit availability, it is not always economically feasible to do so. The electric generator is a primary example. The reliability of the electric generator and thus the availability of the total unit is dependent upon the manufacturers' design considerations and the utilities' operating practices. The past performance of electric generators at fossil steam plants is reviewed and future trends are suggested. Distributions of electric generators by their ratings and installation dates are used to develop these trends. The effects of aging are also considered. The major causes of electric generator outages are defined along with their impact on overall unit availability. The basis for these observations are the data contained in the industry's own Generating Availability Data System operated by the North American Electric Reliability Council.

22421 (EPRI-EL—4658-SR, pp 3.1-3.9) **Generator reliability: a perspective.** Bothwell, J. (Florida Power & Light, Miami). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Electric generator reliability has changed with time and with power demands. Generator reliability is not just a set of numbers or length of time running or the number of forced outages or bottom line figures. It is a complex issue involving communication, pride, commitment, dedication, and sense of responsibility by people at all levels in electric utilities and manufacturers. The problem of improving generator reliability is discussed from an electric utility perspective.

22422 (EPRI-EL—4658-SR, pp 4.1-4.33) **Suggested solutions to generator and exciter problems.** Bothwell, J. (Florida Power & Light, Miami). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The solution of electric generator and exciter problems at Florida Power and Light is discussed. To be able to find solutions requires enthusiasm and dedication of employees and support of upper management to implement solutions. The degree of dedication and support is evident from the number of solutions found. A simple format is used for stating the problem, failure, or symptom, and then the solution.

22423 (EPRI-EL—4658-SR, pp 5.1-5.21) **Monitoring moisture in hydrogen cooled generators.** Bothwell, J. (Florida Power & Light, Miami). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Moisture or water inside hydrogen cooled generators has caused a variety of problems up to and including complete rewinds. In much luckier cases, units have tripped off on phase to ground faults and repairs were limited to only a week outage. Regardless of the magnitude of failure there is a tendency to consider the incident an isolated case which probably will never occur again or as an incident that only affects other plants or other utilities, or more often is not really examined relative to each generator because of lack of information or misunderstanding. It is this last point which is discussed. This study does not answer all questions for all situations but, it is hoped that, it will supply enough information, insight, and thought provoking ideas to provide a basis for sound judgment and evaluation of a moisture in a generator situation.

22424 (EPRI-EL—4658-SR, pp 6.1-6.12) **Improving generator reliability in service.** Kapler, J.; Mori, K. (Ontario Hydro, Toronto). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

For decades maintenance engineers have used some sort of reliability process in order to identify the pieces of equipment which required the most maintenance work or regular replacement or upgrading. The development of more formalized reliability procedures became a powerful tool also in the hands of the designers, planners, operating managers and financial analysts as the benefits of increased equipment performance was more clearly understood. The reliability performance can be measured with relatively high level of accuracy. It can be specified, designed for and measured in service against established targets. A reliability analysis of generators at an eight unit power stations, each unit rates at 500 MW. In 1979 a study was carried out in order to review the generator problems, evaluate the effects of their reliability on the plant life cycle cost and identify cost effective reliability improvements. Results of the study are discussed.

22425 (EPRI-EL—4658-SR, pp 8.1-8.3) **Improving the reliability of old steam turbine generators on the Duke power system.** Reid, H.K. (Duke Power Co., Raleigh, NC). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Duke Power will thoroughly rehabilitate twelve fossil-fired steam turbine generators, whose ages range from 28 to 36 years. The objective is to make these units reliable producers of electricity during the years after 1990. It is estimated that this rehabilitation (including work on turbines, boilers, and support systems, as well as on generators) will provide over 1700 megawatts of reliable capacity, which can be used for peaking, at a very modest cost per kilowatt. This rehabilitation project is described.

22426 (EPRI-EL—4658-SR, pp 9.1-9.12) **Experience with generator hydrogen seals at Northern States Power Company's Sherburne County Generating Plant.** Juip, G.W. (Northern States Power Co., Becker, MN). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The Sherburne County Generating Plant has extensive operating and maintenance experience with hydrogen sealing systems on two, 800 KVA, 3600 rpm generators. The sealing systems are the vacuum type with bronze segmented shaft seal rings. Problems in the following areas have been experienced: installation of new babbitted steel shaft rings, excessive hydrogen leakage due to malfunction of shaft seal rings, particulate contamination of the seal oil, and maintenance and installation of shaft seal housings and rings. These problems have extended planned generator maintenance outages 370 hours at a cost of approximately $1.9 million for replacement power. Approximately 50% of the total forced outage hours on the two units over the past two years has been charge to problems with hydrogen seals. The experience with the generator hydrogen seals is discussed.

22427 (EPRI-EL—4658-SR, pp 10.1-10.7) **Failure at the generator neutrals Four Corners Unit 2 and Cholla Unit 3.** McGlamery, W.R.; Farmer, R.G. (Arizona Public Service Co., Phoenix). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The damage and the causes of two separate but similar incidents, both of which resulted in the destruction of the Y connection at the generator neutrals on two Arizona Public Service Company coal-fired generating units are described. The first incident occurred in June, 1983, on Four Corners Unit 2 which is rated 192 MVA. The second incident occurred in January, 1985, on Cholla Unit 3, rated 321 MVA. Although both incidents were similar in respect to the location and magnitude of the damage sustained by the generating units and their surroundings, the two events were determined to have had similar, but yet different, origins. Similarities in damage to the units extended to the fact that in both cases: (1) the generator neutral busses and compartments were almost totally destroyed; (2) extremely high fault currents existed at the main busses causing extensive damage; (3) the neutral grounding relay did not operate; and (4) the units were ultimately tripped by the

operation of the transformer differential relays. Both units were repaired and put back into service while studies were conducted and recommendations were made to prevent a recurrence of the problems. The analyses of the two events, the conclusions reached, and the recommended action to avoid similar events on APS and other units are presented. The cause of the Four Corners incident became apparent when it was determined that the flexible copper connectors, comprising a portion of the generator neutral, failed during service. The Cholla incident, while similar to the Four Corners problem, did not lend itself to such an apparent solution. The failures of both units are discussed.

22428 (EPRI-EL—4658-SR, pp 11.1-11.4) **Integrated approach to stator winding reliability.** Lyles, J.F. (Ontario Hydro, Toronto). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The approach that Ontario Hydro takes to ensure that improved reliability indices will be achieved for thermoset insulated stator windings presently in use in their hydraulic generator - turbine units is described.

22429 (EPRI-EL—4658-SR, pp 12.1-12.18) **Importance of grounding brushes to the safe ,peration large turbine generators.** Buckley, G.W.; Corkins, R.J. (Detroit Edison Co., MI). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Shaft grounding brushes are used on large turbine generators to prevent build up of voltage on the shaft. If the voltage is allowed to build too high, it will discharge to ground wherever the gap is the smallest. Those components which are most vulnerable to damage are those with the smallest clearances such as the oil pump bearings, hydrogen seals, or the governor shaft bearings. The grounding brushes limit the voltage to safe levels by providing a path for its discharge. When the turbine generator shaft voltage is measured without the brushes in service it displays the typical shape of a capacitor charging and then discharging. In the past, shaft grounding brushes were not installed on some generators or, if installed, were usually neglected. This practice presented no problems as long as the bearing and seal clearances were adequate and the shaft voltage was small. As the clearances were reduced in modern machines, the chances of voltage breakdown across the gap increased, creating a risk of bearing damage. There is more than one source for the voltage that is found on the turbine generator shaft of all machines. The motion of the steam flowing past the turbine blades imparts a voltage on the turbine rotor due to electrostatic charge separation. The excitation system can contribute voltage due to harmonics in the field voltage waveform. Magnetostriction, magnetic asymmetry, and homopolar voltages are other sources. The use of grounding brushes in the safe operation of large turbogenerators is discussed.

22430 (EPRI-EL—4658-SR, pp 13.1-13.4) **History and resolution of generator vibration problems at Riverside Station.** Newell, O.L. (Public Service Co. of Oklahoma, Tulsa). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Riverside Station Unit No. 1 is a 460 MW Supercritical Unit. The turbine generator is a 3600 RPM unit manufactured by Westinghouse Electric Corporation. Throttle conditions are 3334 PSIA, 1000°, 2″ Hg absolute exhaust, 2 flow low pressure with 31″ last row of blades. The generator is rated 525 MVA, 3 phase, 24,000 volts, 60 psig, hydrogen cooled, rigid coupled to a single bearing air cooled brushless exciter. The generator was initially excited in March 1974 and the unit was declared commercial in April 1974. The unit has experienced some problems in the turbine. The generator problems started with the annual inspection in 1976. Dusting of the coil wires and the ground wall at the coil end was found. The dusting may be a separate problem from the frame vibration that developed later. In August 1979, inspection revealed greasing around the center lead bushing where it exited from the lead box, severe chaffing of current transformer (CT) conductor insulation, broken CT support brackets, and voids in the generator seating plate grout. The grout was repoured, two new bushings ordered, CT wiring corrected and top coil support rings were installed to minimize stator end turn movement. Generator vibration and the efforts to correct the problem are described.

22431 (EPRI-EL—4658-SR, pp 14.1-14.5) **Improving availability and reliability of existing plant equipment.** Patel, R. (Northeast Utilities Service Co., Hartford, CT). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The focus of this study is the dilemma utilities face of maintaining existing plant equipment while continuing research on new equipment. Help is needed to keep existing units on-line, and simple ideas may be ignored in the jungle of new innovations and research programs. The examples selected for this study concern only electrical equipment because it represents the most perplexing situation for maintenance engineers. (Electrical equipment is usually considered reliable and hence is taken for granted when it comes to maintenance.) These problems present the most unusual and difficult situations.

22432 (EPRI-EL—4658-SR, pp 15.1-15.20) **Electrical problems that have affected generator reliability.** Baker, T.W. (Tennessee Valley Authority, Chattanooga). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Reliability of generators is expected to go down with age, assuming that initial defects and design weaknesses found in new generators are satisfactorily corrected. The average age of TVA's fossil and hydro generating units is 27 and 42 years, respectively. These units, both fossil and hydro, have been very reliable through the years, but the search for methods by which the reliability of the generators may be improved and/or maintained is continued. General discussions of generator history; generator problems affecting reliability (past and present); and some action taken, and being taken, for improving generator reliability are presented.

22433 (EPRI-EL—4658-SR, pp 16.1-16.6) **PG & E's approach to turbine generator reliability.** Wait, T.R.; Padilla, R.J. (Pacific Gas & Electric, San Francisco, CA). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

The recent addition of over 3400 megawatts of generation capacity to the PG & E system, from the Helms and Diablo Canyon projects, allows resources to be directed with greater emphasis towards plant life extension and increased plant reliability. Generator reliability if receiving a significant portion of these resources. The most significant factors which affect generator reliability are: the generator purchase specification, the class of service, operating practices, and generator maintenance. Each of these factors is discussed and PG & E's major efforts in reliability improvement are identified.

22434 **(EPRI-EL—4894) Optimal power flow: Research and code development: Final report.** Tinney, W.F.; Sun, D.I. (ESCA Corp., Bellevue, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 280p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920285.

A new computer algorithm solves optimum power flow problems by coordinating the scheduling of generators and associated equipment to select the most economical alternatives. Use of this new algorithm can help utilities optimize power generation, power flows in the bulk transmission network, and bus voltages.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 22153, 22155, 22157, 22169, 23095, 23224, 23429, 23532, 23532

22435 (PB—87-139952/XAB) Boiler design criteria for dry sorbent SO_2 control with low-NOx burners: new unit applications. Final report, October 1985-March 1986. Clark, J.P.; Kwasnik, A.F. (Combustion Engineering, Inc., Windsor, CT (USA)). Dec 1986. 42p. NTIS, PC A03/MF A01.

This report describes a study to define boiler modifications required to achieve 70% SO_2 removal with sorbent injection on a large tangentially fired utility boiler without supplemental spray drying. The study is a follow on to a recently completed broader evaluation of boiler-design criteria for sorbent SO_2 control technology. A new 500-MWe utility boiler burning low-sulfur coal was considered to be modified to increase sorbent residence time and decrease gas quench rate to achieve 70% SO_2 removal in the boiler with atmospheric calcium hydrate prepared on-site. A second case was considered where no change was made to gas quench rate or sorbent residence time. The effects of adding a pulverizer to the sorbent preparation/injection system to produce a finer sorbent were determined. Capital costs, cost of electricity, and cost effectiveness per ton of SO_2 removed were developed and compared with the results of the earlier study.

22436 (PB—87-140968/XAB) Lime-spray-dryer flue-gas desulfurization computer model user's manual. Final report, January 1982-April 1986. Dotson, R.L.; Sudhoff, F.A.; Burnett, T.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Jun 1986. 190p. (TVA/PE/EDT—85/20). NTIS, PC A09/MF A01.

This report describes a lime-spray-dryer/baghouse (FORTRAN) computer model that simulates SO_2 removal and permits study of related impacts on design and economics as functions of design parameters and operating conditions for coal-fired electric-generating units. The model allows evaluation of several potential utility design and operating conditions for quick comparative costs of lime-spray drying options on a common-cost basis. Two significant limitations of the model are: the SO_2 removal is based on operating parameter ranges and results developed for low-sulfur coal applications (data on high-sulfur coal applications are lacking) and only an overall system SO_2 removal efficiency (without separate spray-dryer and baghouse components) is calculated. The model projections using medium- (2% sulfur) and high-sulfur coal may be in error, with error increasing with increasing coal sulfur content. Means of overcoming these limitations are proposed. The users manual describes the model and instructions for its use, required input data are detailed, and sample computer runs with output are provided to guide users in identifying applications.

22437 (PB—87-144358/XAB) Controlling pollutant emissions through the supplemental use of natural gas: Phase 1 - bench-scale screening studies. Phase 2 - flow-field evaluation and mixing. Topical report, April 1984-July 1985. Chen, S.L.; Clark, W.D.; Greene, S.B.; Heap, M.P.; Moyeda, D.K. (Energy and Environmental Research Corp., Irvine, CA (USA)). Aug 1985. 169p. NTIS, PC A08/MF A01.

Natural gas can be used to enhance the economic acceptability of eastern coals for power generation under more-stringent environmental regulations. The application of technologies that take advantage of the clean-burning qualities of natural gas offers an attractive and cost-effective option for acid rain precursor control. The report discusses the technical advantages of natural gas over coal and oil as a reburning fuel in conjunction with sorbent injection for combined NOx and SOx control. Experimental results indicate that 60% NOx reduction and 70 percent SO_2 reduction can be achieved when 20% natural gas reburning is combined with hydrate injection under realistic time/temperature furnace profiles. In addition, the report describes the mixing studies on cold flow models of practical applications and discusses the general design guidelines for the reburning fuel and burnout air injection systems.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 23715

22438 (EPRI-EL—4793-Vol.2-App.) Reliability-based design of transmission line structures: Volume 2, Appendixes: Final report. Criswell, M.E.; Vanderbilt, M.D. (Colorado State Univ., Fort Collins (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 226p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920320.

Building a reliable transmission line requires satisfying two primary sets of design criteria - electrical and structural. Reliability-based design procedures provide utilities and structural designers the ability to explicitly consider the statistical distribution of design parameters and to numerically quantify reliability. This volume consists of appendixes containing information on background subjects, design data, and sample applications.

22439 (EPRI-EM—3560-Vol.4) Residential response to time-of-use rates: Volume 4, Assessing RETOU's out-of-sample performance: Final report. Caves, D.W.; Christensen, L.R.; Herriges, J.A.; Windle, R.J. (Christensen (Laurits R.) Associates, Inc., Madison, WI (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 67p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920292.

The goal of the RETOU transferability project was to develop a model that utilities could use to simulate residential customer load changes in response to mandatory time-of-use (TOU) electric rate structures. Technical reports EA-3560, Volumes 1-3, describe the RETOU model and the data used in its estimation. This volume presents the results of using the model to predict customer's response to TOU electricity rates for a utility not included in the initial sample. To assess the potential for transferability we developed a separate model for each of five high quality residential experiments. These models related customer response to the TOU price structure and to conditioning variables such as customer characteristics, climate and appliance holdings. Statistical tests were then carried out to determine whether customer response was consistent across the experiments. These tests confirmed the existence of consistency, and supported the conclusion that it is possible to use a single model to simulate customer response for a wide range of service territories in the United States. 20 figs., 15 tabs.

22440 (PB—87-130902/XAB) Development of extruded and molded straight joint for ultra high-voltage XLPE cable. Shimomura, T.; Ando, K.; Asahi, K.; Sugiyama, K. (Mitsubishi Cable Industries Ltd., Tokyo (Japan)). 1986. 7p. NTIS, PC PC E04/MF E01.

Included in Mitsubishi Cable Industries Review, No. 72, 10-15(Aug 1986).

In Japan, 154-kV crosslinked polyethylene-insulated cables (XLPE) are already in use for long-distance tranmission lines, but 275-kV XLPE cables are used only for short-distance lines (without joints) on the premises of power-generation plants and substations. 275-kV XLPE cable is expected to be used for long-distance transmission lines in the near future because of its overall cost advantage. To respond to this need, a straight-through joint with the same reliability as the cable should be developed. Reliable joints should be formed and molded with the same curable PE compounds as the cable insulation. At present, 154-kV XLPE cables for long-distance transmission lines are usually constructed with the joint comprising XLPE insulation wrapped with curable PE tape and molded by heating. However, this taped molded joint has the disadvantages of troublesome tape handling. On the other hand, extruded molded joints are constructed by injecting curable melted PE into a mold with an extruder, eliminating contamination. The report describes the characteristics of the extruded and molded joint developed for 154, 275 and 500 kV class XLPE cables.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 24378

22441 (INIS-mf—10529) Nuclear power statistics 1985. Oelgaard, P.L. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). Jun 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750664.

In this report an attempt is made to collect literature data on nuclear power production and to present it on graphical form. Data is given not only for 1985, but for a number of years so that the trends in the development of nuclear power can be seen. The global capacity of nuclear power plants in operation and those in operation, under construction, or on order is considered. Further the average capacity factor for nuclear plants of a specific type and for various geographical areas is given. The contribution of nuclear power to the total electricity production is considered for a number of countries and areas. Finally, the accumulated years of commercial operation for the various reactor types up to the end of 1985 is presented.

22442 (UCRL—96081) Elements of a national emergency response system for nuclear accidents. Dickerson, M.H. (Lawrence Livermore National Lab., CA (USA)). 10 Feb 1987. Contract W-7405-ENG-48. 7p. (CONF-870386—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006243.

From Applied systems analysis institute workshop on technological risk in modern society; Laxenburg, Austria (18 Mar 1987).

The purpose of this paper is to suggest elements for a general emergency response system, employed at a national level, to detect, evaluate and assess the consequences of a radiological atmospheric release occurring within or outside of national boundaries. These elements are focused on the total aspect of emergency response ranging from providing an initial alarm to a total assessment of the environmental and health effects. Elements of the emergency response system are described in such a way that existing resources can be directly applied if appropriate; if not, newly developed or an expansion of existing resources can be employed. The major thrust of this paper is toward a philosophical discussion and general description of resources that would be required to implementation. If the major features of this proposal system are judged desirable for implementation, then the next level of detail can be added. The philosophy underlying this paper is preparedness - preparedness through planning, awareness and the application of technology. More specifically, it is establishment of reasonable guidelines including the definition of reference and protective action levels for public exposure to accidents involving nuclear material; education of the public, government officials and the news media; and the application of models and measurements coupled to computer systems to address a series of questions related to emergency planning, response and assessment. It is the role of a proven national emergency response system to provide reliable, quality-controlled information to decision makers for the management of environmental crises.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 22518, 22522, 22556, 22563, 22564, 22565, 22570, 22573, 22579, 22580, 22587, 22590, 22592, 22596, 22597, 22605, 22607, 22612, 22613

22443 (INIS-mf—10319) Lingen Nuclear Power Plant. Annual report 1985. (Kernkraftwerk Lingen G.m.b.H., Darme/Lingen (Germany, F.R.)). 1986. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751191.

Report on the legal and scientific foundations, operation in the decommissioning phase, staff, balance sheet, profit-and-loss account in 1985.

22444 (INIS-mf—10569) Quarterly report of the Swedish Nuclear Power Inspectorate. 4th quarter 1985. (Swedish Nuclear Power Inspectorate, Stockholm). 1985. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750906.

No serious fault has occurred during the period. Forsmark 3 has continued its test operation. Barsebaeck 1 and 2 have got the permission to increase their output by 6 percent. The pressure release device, FILTRA has been connected to the reactors at Barsebaeck. Recommendation concerning accident abatement have been passed to the Swedish government. (G.B.).

22445 (JAERI-M—86-009, pp 6-26) Role of software in research of thermal-hydraulic. Kagawa, Tatsuo. (Toshiba Corp., Kawasaki, Kanagawa, Japan). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Toshiba constructed a test loop in 1982 and began a test program investigating core thermal-hydraulics both in the steady state condition and transient condition, in cooperation with electric power companies. Experiments of boiling transition (BT), void fraction distribution, thermo-hydraulic stability, and transient BT were performed. With these experimental data, usually used correlations for design and evaluation methods were examined. Since most of those correlations are empirical, they cannot be applicable in the original style to the situations of new types of core and fuel rods. Therefore, more theoretical and more generic equations are required. In this report, described are the present status, problems and possibilities of such an approach. The case of subchannel analysis in relation to BT is taken as an example because it is very important.

22446 (JAERI-M—86-009) Proceedings of the second seminar on software development in nuclear energy research. (Japan Atomic Energy Research Inst., Tokyo). Mar 1986. 216p. (In Japanese). (CONF-8509372—). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110.

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Separate abstracts were prepared for the individual papers of this conference. (JDB)

22447 (NUREG/CR—4744-Vol.1-No.1) Long-term embrittlement of cast duplex stainless steels in LWR systems: Semiannual report, October 1985-March 1986. Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31109-ENG-38. 45p. (ANL—86-54-Vol.1-No.1). NTIS, PC A03/MF A01 - GPO. File Number TI87005737.

This progress report summarizes work performed by Argonne National laboratory on long-term embrittlement of cast duplex stainless steels in LWR systems during the six months from October 1985 to March 1986.

22448 Accounting for changing source distributions in light water reactor surveillance dosimetry analysis. Maerker, R.E.; Williams, M.L.; Broadhead, B.L. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). *Nuclear Science and Engineering;* **94**: No. 4, 291-308(Dec 1986).

A technique is described to account for effects of space- and time-dependent core source variations on pressure vessel surveillance dosimetry analysis. The procedure first defines an easily implemented geometry for a single adjoint transport calculation. The results from the adjoint calculation can then be combined with those from a single forward calculation, in conjunction with an adjoint scaling technique, to yield activities and pressure vessel fluxes simultaneously for a wide range of source distributions, dosimeter response functions, and detector locations. This method has been implemented in the LEPRICON code system for vessel fluence determination. An application to an R-θ model of an operating power reactor shows that effects of source perturbations resulting in 20% changes in the core leakage can be predicted within — 3% at both

downcomer and cavity dosimeter locations, for six different dosimeters, by choice of a single suitable adjoint response function.

22449 **Limit cycles and bifurcations in nuclear systems.** Cacuci, D.G.; March-Leuba, J.; Perez, R.B. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **53**: 239-241(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Recent stability tests have shown that boiling water reactors (BWRs) are susceptible to reactivity instabilities when operated at low-flow conditions. When such instabilities occur, limit cycles are observed in the measured process signals, indicating that these instabilities cause a transition between a linear regime (normal operation) and a nonlinear regime (unstable operation in the linear sense). The purpose of this paper is to describe the phenomenological dynamical behavior of BWRs in the nonlinear regime under deterministic and stochastic excitations.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 22444, 22446, 22447, 22448, 22483, 22503, 22504, 22505, 22506, 22507, 22510, 22511, 22522, 22524, 22525, 22526, 22528, 22530, 22536, 22537, 22538, 22540, 22542, 22544, 22547, 22550, 22551, 22556, 22560, 22563, 22564, 22566, 22567, 22568, 22570, 22573, 22578, 22580, 22581, 22587, 22588, 22589, 22592, 22593, 22594, 22595, 22596, 22597, 22599, 22602, 22605, 22606, 22613, 23984, 24060

22450 **(CEA-CONF—8509) Refabrication of spent fuel pins provided with instrumentation by means of the FABRICE process.** Garcia, A.; Malard, J.P.; Mery, M.; Vouillot, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). May 1986. 18p. (In French). (CONF-8605196—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750984.

From EEC hot laboratories meeting; Brasimone, Italy (21 May 1986).

The FABRICE "hot cell refabrication" process for small pins from very long irradiated fuel elements was developed at the CEA to allow parametic studies of the irradiation behavior of pins from nuclear power plants. The present note describes the adaptation of techniques to the fabrication of pins provided with important instrumentations.

22451 (EPRI-EL—4658-SR, pp 17.1-17.7) **High moisture content in generator hydrogen gas system.** Kennamer, O.W. (Alabama Power Co., Birmingham). Oct 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920080. (CONF-8512101—).

From Workshop on generator reliability; Scottsdale, AZ, USA (3 Dec 1985).

Alabama Power Company owns and operates J.M. Farley Nuclear Plant Units 1 and 2. The nuclear steam supply system (NSSS) and the turbine generators (TG) were supplied by Westinghouse Electric Corporation. The TG ratings are as follows: KVA - 104,500; Stator Amperes - 27,424; Power Factor - 0.85; and Rotor Amperes 8703. On September 10, 1981 the Unit 1 generator failed with electrical faults on all three phases. Recovery from this failure required rewinding the generator stator and replacing a considerable amount of iron in the generator. The outage for this work was six months in duration. Major contributing factors related to the failure were the formation of lead carbonate in the generator and high moisture content in the generator hydrogen gas system. It is believed that a high moisture content in the generator hydrogen gas system (hydrogen dryer was inoperable) and organic acids (released from the insulation) caused corrosion (lead carbonate) of the lead solder used on the hydrogen gas cooler fins. The lead carbonate was transported from the cooler fins by the hydrogen gas and deposited throughout the generator. The problems caused by high moisture content in the generator hydrogen gas system are discussed.

22452 (IA—1421, pp 23-24) **Testing the UTSG DSNP module simulation of a LOFW transient.** Gal, D.; Saphier, D.; Elias, E. (Israel Atomic Energy Commission, Tel Aviv; Technion-Israel Inst. of Tech., Haifa). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

22453 (INIS-mf—10577, pp 11-12) **Behaviour of corrosion products in the primary circuit of pressurized water reactor.** Burclova, J.; Barta, O.; Duris, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia; Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia; Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

22454 (INIS-mf—10577, pp 79-83) **Radionuclide migration in primary circuit of nuclear power plant.** Tomik, L.; Duris, I.; Blazek, I.; Burclova, I.; Melichar, E. (Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia; Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 21 Apr 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

22455 (INIS-mf—10580-Vol.2, pp 103-108) **Prognoses of gamma-radiation fields on the power plants with WWER-440 and WWER-1000 reactors and comparison of the expected dose rates with measured values.** Gerullis, V.; Khil'sberg, I.; Khenchel', K.; Pikkshnajder, Yu.; Gyune, F. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The criteria for measurement points selection and the requirements to measuring are identified with the objective of a comparison of the obtained data with the calculated dose rates for power plants. On the basis of the measurements and calculations carried out by the authors an evaluation has been done of the feasibility of a reliable prognosis for the gamma-radiation dose rate fields at the power plants with WWER-440 and WWER-1000 reactors with the use of design models. 2 refs.; 5 figs.

22456 (JAERI-M—86-009, pp 130-146) **Thermodynamic problems on HCPWR.** Akiyama, Mie. (Mitsubishi Atomic Power Industries, Inc., Tokyo, Japan). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

A HCPWR design uses the high compact lattice core of 1 to 2 mm fuel rod pitch in order to decrease the water volume fraction to fuel. But such high compactness is considered to cause the decrease of coolant flow rate due to the increase of core pressure loss. And the high compactness also affects the DNB phenomena itself which is directly related to the output performance. Moreover, the coolability of the reactor core is considered to be affected at an accident. It is one of the most important problems for realizing a HCPWR plant whether or not we can design a reactor that preserves the output performance under the consideration of such thermodynamic affections. The thermodynamic affections caused by high compactness are arranged in this report, and the further research problems on HCPWR are also considered on presently available knowledge.

22457 (KFK—4148) Parametric thermohydraulic calculations for advanced pressurized water reactors with the code HADA-2. Cigarini, M.; Dalle Donne, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Oct 1986. 122p. (EUR—10532e). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751333.

The paper describes the improvements introduced in the computer code HADA for the thermohydraulic design of Advanced Pressurized Water Reactors. The main modifications are the use of the water enthalpy, rather than the water temperature, for the equation giving the limitation due to the hot channel factor, and the introduction of a correction factor to ensure that the ratio between the critical heat flux and the hot channel heat flux is always greater than 1.3. About 200 different reactors have been calculated with the improved version HADA-2 of the code. The main results of these calculations are that, in the range of interest, homogeneous and heterogeneous reactors are about equivalent (same net electrical output of the plant for the same ratio between water and fuel rod volume). For the homogeneous reactors the optimum designs are for H/d=20 (H=axial pitch of the integral spiral ribs on fuel rod surface, d=diameter of the fuel rod) and for the heterogeneous reactors for H/d=35.

22458 (KFK—4162) Thermal and mechanical behavior of APWR-claddings under critical heat flux conditions. Diegele, E.; Rust, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Oct 1986. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751208.

Helical grid spacers, such as three or six helical fins as integral part of the claddings, are regarded as a more convenient design for the very tight lattice of an advanced pressurized water reactor (APWR) than grid spacers usually used. Furthermore, it is expected that this spacer design allows an increased safety margin against the critical heat flux (CHF), the knowledge of which is important for design, licensing, and operation of water cooled reactors. To address the distribution of the heat flux density at the outer circumference of the cladding geometry under investigation, the temperature fields in claddings without as well with fins were calculated taking into consideration nuclear and electrically heated rods. Besides the thermal behavior of the claddings, the magnitude and distribution of thermal stresses were determined additionally. A locally increased surface heat flux up to about 40 percent was calculated for the fin bases of nuclear as well as indirect electrically heated claddings with six such helical fins. For all investigated cases, the VON MISES stresses are clearly lower than 200 MPa, implying that no plastic deformations are to be expected. The aim of this theoretical analysis is to allow a qualitative assessment of the finned tube conception and to support experimental investigations concerning the critical heat flux.

22459 (STUK-A—49) Spent fuel measurements at Loviisa Nuclear Power Station May 1982. Tarvainen, M.; Riihonen, M. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Feb 1984. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750676.

First interim report to technical contract No. 2950/TC between IAEA and STUK entitled Field testing and developing of spent fuel NDA-measurements techniques.

High resolution gamma-ray spectrometry techniques were used to measure nondestructively five VVER-type spent fuel assemblies. Two of the assemblies had the initial enrichment of 2.4% and three the enrichment of 3.6%. The burnup values of the measured assemblies were from 24.29 to 34.76 GWd/tU. The correlation of the "1"3"4Cs/"1"3"7Cs -activity ratio with burnup was investigated. The measured axial burnup profiles were compared with the declared profiles. The aim was also to investigate if the semiempirical formulae introduced by Golubev and Fedotov can be used. The measured relative burnup distributions were consistent with declared profiles. The results of the "1"3"4Cs/"1"3"7Cs-activity ratio measurements proved to be inconsistent with the results of the semiempirical formulae of Golubev and Fedotov. Better consistency may, however, be expected if the power history correction is taken into account in the measured data. Twenty four irradiated fuel assemblies of 2.4% and 3.6% enrichment were measured nondestructively using passive neutron techniques. The correlation between neutron signature and operator-declared values of burnup was evaluated. The neutron measurements indicate that neutron count rate versus burnup can be expressed in the form of a power function. The regression coefficients seem to depend on the initial enrichment and irradiation history. The gross gamma intensities were measured by and ionization chamber at the same time the neutron measurements were made.

22460 Performance evaluation of the courant limit violating numerical method in RELAP5/MOD2. Makowitz, H. (Idaho National Engineering Lab., Idaho Falls). *Transactions of the American Nuclear Society;* **53**: 260-261(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The RELAP5/MOD2 computer code is a general-purpose six-equation, one-dimensional, semi-implicit or nearly-implicit, two-phase, time-dependent, thermal-hydraulic computer simulation program for steam/water nuclear reactor system modeling. For problems where the flow is expected to change very slowly with time, it is possible to obtain adequate information from an approximate solution based on very large time steps with RELAP5/MOD2, which violates the convective (material) Courant limit. The approximate solution method used to obtain such very large time steps is a fractional step (sometimes called multiple step) method named the nearly implicit method. A computational performance evaluation has been conducted of this new method, using a 4-in. cold-leg break 1000-s sequence, for a pressurized water reactor (PWR) model based on the Zion I PWR used in previous studies. A comparison is made to RELAP5/MOD1 studies which utilized concurrent multiprocessing. As in previous analysis, parallel and vector enhancements are discussed in the context of real-time best-estimate simulation.

22461 Case study of the propagation of a small flaw under PWR loading conditions and comparison with the ASME Code design life comparison of ASME Code Sections III and XI. Yahr, G.T.; Gwaltney, R.C.; Richardson, A.K.; Server, W.L. (Oak Ridge National Lab., Oak Ridge, TN). pp 55-68 of Symposium on ASME codes and recent advances in PVP and valve technology including a survey of operations research methods in engineering. Fong, J.T.; Hollinger, G.L.; Gowda, B.; Ezekoye, L.I.; Levary, R.R. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—). Contract AC05-84OR21400.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

A cooperative study was performed by EG&G Idaho, Inc., and Oak Ridge National Laboratory to investigate the degree of conservatism and consistency in the ASME Boiler and Pressure Vessel Code Sect. III fatigue evaluation procedure and Sect. XI flaw acceptance standards. A single, realistic, sample problem was analyzed to determine the significance of certain points of criticism made of an earlier parametric study by staff members of the Division of Engineering Standards of the Nuclear Regulatory Commission. The problem was based on a semielliptical flaw located on the inside surface of the hot-leg piping at the reactor vessel safe-end weld for the Zion-1 pressurized-water reactor (PWR). When the analyses were extended past the design life, the usage factor was less than 1.0 when the flaw had propagated to failure. The current study shows that the criticism of the earlier report should not detract from the conclusion that if a component experiences a high level of cyclic stress corresponding to a fatigue usage factor near 1.0, very small cracks can propagate to unacceptable sizes.

22462 Measured proof of breeding of the light water breeder reactor. Schick, W.C. Jr.; Beaudoin, B.R.; Beggs, W.J.; Freeman, L.B.; Goldberg, I.; Hecker, H.C.; Kahler, A.C.; Tessler, G.; Raab, H.F. (Bettis Atomic Power Lab., West Mifflin, PA). *Transactions of the American Nuclear Society;* **53**: 476-477(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Proof of self-sustaining breeding in the light water breeder reactor (LWBR) would mean that this proven pressurized water reactor (PWR) could provide our nation with an energy option from plentiful thorium about 50 times larger than that provided by current commercial reactions. Assay measurements to date of expended fuel elements from the LWBR indicate successful breeding. Bettis Atomic Power Laboratory designed and built a LWBR under technical direction of the US Department of Energy's Office of Naval Reactors. The core produced 60 MW(e) in the nation's first large-scale nuclear power plant, Shippingport, which was operated by Duquesne Light Company to provide electric power to the Pittsburgh area. The LWBR core operated from 1977 to 1982 for about 29,000 equivalent full-power hours. To date, more than 350 rods from eight fuel modules have been assayed. The EOL fissile content of these modules was deduced from assay results and compared with calculated loadings. LWBR breeding performance was estimated based on the results from assay of the first eight modules. The ratio of the EOL core fissile content to the initial value is called the fissile inventory ratio (FIR). An FIR >1.0 indicates breeding. Allowing for an estimated fuel reprocessing loss of 0.5%, FIR >1.005 would provide a self-sustaining fuel cycle. The authors presently estimate that FIR lies between 1.012 and 1.015, compared to a predicted value of 1.0135.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 22523, 22527, 22951

22463 **(INIS-mf—10320) Experimental investigations of a fast sphere discharge system, a safety device for the pebble bed HTGR.** Buchmann, R. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 16 Feb 1984. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751182.

The discharge tubing system takes the fuel elements to the underground store. With a tube diameter of 0.80 m, the danger of top or side reflector pieces broken off jamming the tube is banned. Little rise in temperature of the tube during guide discharge allows the use of conventional materials for cold tubing. The sealing device is a recent development: it plunger automtically pashes against the discharge opening. Helium density of this primary system seal is ensured by a rupture disk between plunger and discharge opening. In the reflector, there is a safety fuse closing the pressure relief lead of the pneumatic plunger holding system. When the core centre temperature reaches an inadmissible level, this fuse will respond causing the plunger to go down by its own weight and to unlock the discharge opening. The rupture disk will then be destroyed by the elements pressing on it. Instead of using indirect cooling methods for the underground store as has been preferred to date, direct water cooling is applied. The hot fuel elements drop into a water pool and cool down within a few minutes. Accidents due to incoming water or air are eliminated this way. In the course of quenching no vapour develops provided that the water pool is big enough. The water gas reaction of hot modular graphite and water produces but very small quantities of combustible gases. The limit of inflammability of 4% of hydrogen in air will be missed by far, even under most adverse conditions, the value being 0.2%. As a result, there is little corrosion at the fuel element surface so that re-use of the fuel elements is not impaired.

22464 **(INIS-mf—10321) Hochtemperatur-Kernkraftwerk GmbH (HKG). Annual report 1985.** (Hochtemperatur-Kernkraftwerk G.m.b.H. (HKG), Hamm (Germany, F.R.)). 1986. 23p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751181.

The annual report presents the agenda of the general meeting of members, held on July 3, 1986 at Hamm-Uentrop, the report of the managing board, and the annual financial statement as of December 31, 1985, including the profit and loss account of the period January 1 to December 31, 1985. The object of the HKG GmbH is the planning, financing, installation, and operation of the Hamm-Uentrop nuclear power station equipped with a high-temperature reactor, as a joint enterprise of the European partners.

22465 **(Juel—2072) Phenomena in the reactor protection building of a medium-sized high temperature reactor during a core heat-up accident with emphasis on the formation of gas layering.** Marx, F.P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung; Technische Hochschule Aachen (Germany, F.R.)). Jul 1986. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751219.

Accidents are conceivable for medium- and large-sized HTR's equipped with a prestressed concrete reactor pressure vessel (PCRV) leading not only to the escape of hot helium but also of combustible gases into the containment. Whether and at what time the containment is endangered by the formation of ignitable mixtures depends, amongst other factors, on the formation of gas and temperature layers. Studies using a computer model adapted to HTR conditions have shown that during depressurization of the primary circuit helium and temperature layers arise in the containment which, however, are then rapidly reduced after the end of depressurization so that at the start of combustible gas release, beginning later, the containment atmosphere is homogeneously mixed. The combustible gas jet only causes slight gas layering since continuous convective mixing takes place due to cooling at the containment structures. Under the selected conditions, ignitable mixtures are formed temporarily in the pressure-resistant, closed containment over the entire space. This can be ruled out with a ventilated containment (confinement), if the intake of air from outside due to negative pressure after the depressurization can be prevented. Without additional steam feeding, the atmospheric humidity is not sufficient to saturate the containment atmosphere. Although the addition of water vapor leads to saturation the quantity of condensed water remains so slight that in the case of a gas ignition its vaporization heat can bind practically no combustion energy resulting in a reduction of the pressure build-up in the containment. This could only be achieved by spraying water in the course of the ignition phase.

22466 **(Juel—2073) New experimental facility for the investigation of hydrogen isotopes permeation through heat exchanger tubes with sweep gas intermediate circuit under nuclear conditions.** Mueller, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Jul 1986. 169p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751348.

In this work a new experimental facility is presented to study the permeation of hydrogen isotopes (tritium and protium) through heat exchanger tubes with sweep gas intermediate circuit under process gas conditions. Beside temperature and pressure dependant measurements to determine the permeation data of Incoloy 800 H double wall tubes further parameter investigations have been made to study the action of a sweep gas circuit against hydrogen permeation. The experimental results show that the obtained impending factor could be destinctly increased.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 22561, 22562, 22584

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 22446, 22462, 22515, 22519, 22557, 22558, 22580, 22853

22467 **(CTA-IEAV-RP—010/86) Optimization of binary breeder reactor IV - Conception of mixed fuel at central part of the core.** Dias, A.F.; Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Apr 1986. 33p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701612.

Neutronic characteristics of some LMFBRs are analized for a fueling mode that is different from those reported previously. In an inner part of the core both /sup 233/U//sup 232/Th and Pu/U assemblies are placed while the outer zone is fueled with Pu/U as-

semblies. Both oxide metal fuels and /sup 232/Th and /sup 238/U blankets are considered.

22468 (CTA-IEAV-RP—014/86) Optimization of binary breeder reactor V - Binary breeder reactors with two and four zones and a conventional LMFBR - (Pu/U) of two zones. Dias, A.F.; Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Apr 1986. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701613.

Comparative analyses of a commercial-size Pu/U-fueled liquid metal fast breeder reactor and two binary breeder reactors with different numbers of enrichment zones have been done. Principal parameters of comparison are safety and breeding characteristics and reactivity losses during an operational cycle. The comparison shows that in a binary breeder reactor, good breeding characteristics in both cycles, Pu/U and U/Th, in addition to a possibility of an efficient utilization of thorium, and superior inherent safety than current LMFBRs can be achieved.

22469 (KFK—4093) Numerical simulation of multiphase-multicomponent-flow after fuel rod failure in a sodium filled coolant channel. Misu, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Oct 1986. 197p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87751331.

The CALIPSO-code has been developed for theoretical description of thermal - and fluiddynamic phenomena occuring after clad failure in sodium filled channels of fast breeder reactors. Important parts of a pubiished code version were improved. The new code version was tested by means of experimental results from selected SIMBATH experiments simulating material relocation after pin failure. The CALIPSO code was extended in the following main aspects: The geometry model was improved in order to allow for realistic representation of the SIMBATH test section and of its sodium loop. Separate momentum equations were solved for the fuel (thermite), the liquid sodium, and the gasphase in order to have a detailed consideration of nonequilibrium effects and of material relocations inside the multicomponent-multiphase flows. An energy equation for the noncondensable gases was added to the model. Based on knowledge from twophase flow dynamics different flow regime models were included. Flow regime depended correlations for calculation of wall and intercomponent friction forces as well as of heat transfer rates were added to these models. The time dependent spacial distribution of different flow regimes inside the pin and in the coolant channel is determined by an appropriate flow regime map. A new formulation of the discretized form of conservation equations for mesh cells with variable width and length was implemented. The numerical method also accounts correctly for the total pressure variation at positions with abrupt area changes.

22470 (KFK—4129) Dynamic tensile tests with superimposed ultrasonic oscillations applied to stainless steel. Schinke, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Sep 1986. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87751234.

For the analysis of the mechanical consequences of core disruptive accidents in Fast Breeder Reactors various computer codes have been developed in the European Community. In recent years an extensive assessment has been performed by comparing the results of these codes with explosion tests in waterfilled vessels (COVA-experiments). Common to the various codes, a systematic underestimation of the vessel strains was found. In the COVA tests high frequency pressure oscillations were observed and thus it was conjectured that the phenomenon of "acoustic softening" might be relevant in explaining the discrepancies in the strains. To validate this conjecture a hydro-pneumatic tensile test apparatus was developed which allows dynamic tensile testing at room temperature with and without superimposed ultrasonic oscillations (40 kHz). The mean strain rate can be varied from 5 x 10/sup -5/ to 30 s/sup -1/ and the ultrasound intensity may amount up to 30 W/mm/sup -2/. The test specimens were fabricated from the actual COVA sheet material (stainless steel type 321).

22471 (KFK—4139) Consulting core surveillance system COCOSS I at KNK II. Hoffmann, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Oct 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751330.

Fuel cladding defects cannot be avoided in nuclear power plant operation. In the worst case they may lead to loop contamination or to local cooling disturbance. Especially in case of the liquid metal cooled fast breeder reactor, continuation of plant operation or power set back calls for an expert who possesses comprehensive knowledge of (a) detection and location of failed subassemblies, (b) behavior of failed subassemblies, and (c) questions of safety of the plant while operated with faulty subassemblies. Since such an expert cannot be permanently available, it is intended to transfer this expert knowledge to the COCOSS 'Consulting Core Surveillance System'. This report gives a description of the status of COCOSS as operated at present at KNK II as a measuring data acquisition and evaluation system. In the final stage of implementation COCOSS - inserted in a large diagnosis system - is to make the same calculations for the reactor operator and to give him the same recommendations as he receives now from an expert commanding of an extensive knowledge in this specialized field.

22472 (UJV—7537-T) Experimental research of local hydrodynamic characteristics of fast reactor fuel assembly peripheral zone. 4. Results of measurement at disturbed geometry. PORGEVY 1, PORGEVY 0 variants. Hejna, J.; Cervenka, J.; Vosahlo, L.; Smid, J.; Mantlik, F. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Feb 1986. 100p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701628.

For Part 3 see report UJV--6483-T (May 1983).

Measurements were made of shear stress distribution and the velocity field of an aerodynamic model of the fast breeder reactor fuel assembly periphery. The effect was studied of a 50% disturbance of the geometry of a corner rod in a fuel assembly as against normal geometry. The coefficient of friction in the channel was assessed in dependence on the Reynolds number. The distribution of shear stresses in the walls of the fuel assembly and on spacers is graphically represented. (M.D.).

22473 (WAPD-TM—1250) LWBR development program: Flow-induced vibrational wear behavior of zircaloy clad simulated fuel rods in a grid support system. Galtz, C.S.; Stackhouse, R.M.; Campbell, W.R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Mar 1987. Contract AC11-76PN00014. 84p. NTIS, PC A05. File Number DE87006199.

Vibrational wear behavior of flow-tested simulated fuel rods supported in AM-350 stainless steel grids is described. Zircaloy-4 tubes containing copper pellets were tested in 515 and 530°F, 1615 and 2000 psia, upward flowing water at various flow rates for periods of 420 to 11,871 hours while supported by normal and off-normal grid conditions. The simulated fuel rods were attached at either top or bottom base plates. Rod wear spots were usually deepest at the free end grid level. Wear spots 9.9 to 17.0 mils deep were produced on several rods for off-normal conditions where the grid closest to the rod free end did not apply spring force to the rod. Expected core conditions are less severe due to a continual shift in rod-grid contact locations as rods lengthen from irradiation induced growth. High wear at free-end grids was most common on top-mounted rods, but it was observed on bottom-mounted rods also.

22474 **Thermal impact of $Na_3(U/sub\ 1\text{-}y/Pu/sub\ y/)O_4$ formation on a breached LMR fuel element.** Lee, M.J.; Strain, R.V.; Lambert, J.D.B.; Feldman, E.E.; Shibahara, I. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 215-216(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Continuous reactor operation with a limited number of breached elements is highly desirably for plant availability and fuel cycle economy. There are, however, concerns about breached element behavior and associated operation consequences that have not been addressed. These concerns are currently being investigated under the run-beyond-cladding-breach (RBCB) program in Experimental Breeder Reactor-II, a program jointly sponsored by the US Department of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan. Anomalous behavior of the breached element initiates from the formation of the compound $Na_3(U/sub\ 1\text{-}y/Pu/sub\ y/)O_4$ (heretofore called reaction product) at the fuel surface immediately adjacent to the cladding. To investigate the impact of reaction product formation, test elements with different initial burnup and different linear power were irradiated for about 150 full-power days. Cladding breaches were simulated by predrilled pin holes in the plenum region. Consequently, thermal analyses were carried out to evaluate the fuel temperature perturbation basing on the ceramograph from destructive examination, the irradiation history, and the fabrication data of the test element. These analyses clearly indicate the sources and impact of thermal perturbation occurring in a breached element that must be considered in a fuel element design if RBCB is accepted as a viable mode of reactor operation.

22475 **Metallography of thoria-based fuel materials.** Katz, O.M. (DOE/Westinghouse, Pittsburgh, PA). *Microstructural Science;* **13**: 151-175([1987]).

Thoria and mixed thoria-urania fuel pellets were used to power the light-water breeder reactor (LWBR) installed at Shippingport, Pennsylvania, and a compilation of this technology was recently authorized for public consumption. Metallography using light, electron, and X-ray sources played a substantial part in understanding the behavior of the fuel in the powder and pellet forms, in both the unirradiated and irradiated conditions. Sinterability was determined by the shapes of comminuted starting powder particles. Reactor fuel pellet processing changes were instituted because of the metallographic data generated, especially when contaminants were found to have a disproportionate effect on properties due to concentration at key locations such as surfaces and grain boundary tri-junction.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

22476 **(CONF-870102—13) Considerations pertinent to the Doppler effect for space reactors.** Hwang, R.N. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007032.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Because of the potential importance of the Doppler effect to the safety considerations of compact fast spectrum reactors for space applications, extensive investigations have been carried out. The purpose of this paper is two-fold. First, the magnitude of the Doppler reactivity of such reactors will be estimated. Secondly, some relevant questions concerning the fundamental nature of the problems will be addressed. In the present study, a generic space reactor design having features of current designs is examined. In R-Z geometry, the reactor consists of 3 core regions which are made of UN with various enrichments mixed in with a W/Re matrix and coolant channels filled with ^7Li and surrounded by Mo-vessel and beryllium oxide reflector along with external control drums made of B_4C in the radial direction and accompanied by axial regions. The axial region above the core contains BeO with W/Re structure. The enrichment increases as a function of radius to provide an approximately constant power distribution in the core regions. Hence, the temperature distribution is also expected to be approximately constant in various core regions. The Doppler reactivities will be given for various radial and axial regions.

22477 **(DOE/NASA/1005—12) Overview of free-piston Stirling engine technology for space power application.** Slaby, J.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AI05-82OR21005. 21p. (NASA-TM—88886; CONF-870307—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002961.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

An overview is presented of the National Aeronautics and Space Administration (NASA) Lewis Research Center (LeRC) free-piston Stirling engine activities directed toward space-power application. One of the major elements of the program is the development of advanced power conversion of which the Stirling cycle is a viable candidate. Under this program the status of the 25 kWe opposed-piston Space Power Demonstrator Engine (SPDE) is presented. Technology work is also conducted on heat-exchanger concepts, both design and fabrication, to minimize the number of joints as well as to enhance the heat transfer in the heater. Design parameters and conceptual design features are also presented for a 25 kWe, single-cylinder free-piston Stirling space-power converter. Projections are made for future space-power requirements over the next few decades along with a recommendation to consider the use of dynamic power-conversion systems - either solar or nuclear. A description of a study to investigate the feasibility of scaling a single-cylinder free-piston Stirling space-power module to the 150 kWe power range is presented.

22478 **Design and acquisition process for the Multimegawatt Terrestrial Power Plant.** Gertz, C.P.; Bowman, A.L. (EG & G Idaho, Idaho Falls). *Transactions of the American Nuclear Society;* **53**: 14(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

In August 1984, the USAF entered into a joint agreement with the US Department of Energy (DOE) to consider with the US Department of Energy (DOE) to consider nuclear energy as an alternative to meet secure power requirements. With USAF approval, the DOE began development of the Multimegawatt Terrestrial Power Plant (MTPP), a nuclear reactor power plant capable of providing safe, sustained, secure, reliable, and economic power to key mission facilities. The MTPP would provide base-load electricity and/or thermal energy as well as energy to key mission facilities. The plant would operate for extended time periods (months or years) without refueling and be independent of off-site support. The MTPP is to be designed to the most modern standards and is to meet USAF and DOE design requirements. Except for a few unique features that assure the plant is capable of supporting military missions, the design would meet licensing criteria. A few of the major design criteria are described. Procurement, & design efforts are also discussed.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 22491, 22680

22479 **(DOE/OR/00033—T286) Regulation and the nuclear option: Summary of a workshop on long-range nuclear power regulatory issues, August 20-21, 1986.** Barkenbus, J.N.; Weinberg, A.M. (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 105p. NTIS MF A01; 2; GPO Dep. File Number DE87005906.

Nuclear reactor regulation is discussed in the light of institutional and technological changes and analytical tools for failure and risk analysis. It is suggested that distinctions be drawn between higher risk and lower risk reactor operations and that lower-risk operations be afforded more autonomy. Discussion of public acceptability emphasized political accommodation entailing development of a future generation of inherently safe reactors and a commitment to fix existing reactors and increase solar energy research. Several statements on regulatory reform are appended as well as the NRC's advanced reactor policy. (LEW)

22480 (NUREG—0304-Vol.11-No.4) Regulatory and technical reports (abstract index journal): Annual compilation for 1986. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). Mar 1987. 218p. NTIS, PC A10/MF A01 - GPO. File Number TI87900559.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

2108 Economics

REFER ALSO TO CITATION(S) 22514

22481 (IFE/KR/E—86/001) Nuclear power - status and development 1985/1986. Lingjaerde, R.O. (Institute for Energy Technology, Kjeller (Norway)). Aug 1986. 27p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750689.

A review of the present global position of nuclear power is given. Topics as power-generating capasity, reactor economy, reactor operation experience, uranium requirement, and reprocessing of spent fuel are briefly dealt with.

22482 (PPA-T—45) Approach to studying the nuclear power option in Malaysia. Jamal Khair Ibrahim; Mohamad Zam Zam. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). 1986. 13p. (IAEA-SR—124/20). NTIS (US Sales Only), PC A02/MF A01 . File Number DE87701627.

As a rapid growth in industrialisation and population policy, energy consumption in Malaysia has increased cosiderably. The nation is pursuing a course of diversification of primary energy sources: gas, hydro, coal and oil. Recently nuclear power programme is assessed and evaluated as another energy option in the fuel strategy. Studies of infrastructure, manpower technological and other related considerations are included. Impacts and policy implications of the introduction of nuclear power in Malaysia are also discussed. (A.J.).

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 22611, 23368, 24059

22483 (JAERI-M—86-009, pp 99-129) **Reactor physics problems on HCPWR.** Ishiguro, Yukio; Akie, Hiroshi; Kaneko, Kunio; Sasaki, Makoto. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Reactor physics problems on high conversion pressurized water reactors (HCPWRs) are discussed. Described in this report are outline of the HCPWR, expected accuracy for the various reactor physical qualities, and method for K-effective calculation in the resonance energy area. And requested further research problems are shown. The target value of the conversion ratio are also discussed.

22484 (KFK—4116) TPTRIA - a computer program for the reactivity and kinetic parameters for two-dimensional triangular geometry by transport perturbation theory. Kobayashi, K.; Buckel, G.; Kuefner, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Oct 1986. 104p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751205.

FORTRAN-77.

TPTRIA is a FORTRAN-77 program for the calculation of the reactivity, effective delayed neutron fractions and mean generation time for two-dimensional triangular geometry on the basis of neutron transport perturbation theory. Group cross-sections, microscopic data of delayed neutron fractions and spectra, isotope dependent prompt neutron fission spectrum, and direct and adjoint angular fluxes provided by the corresponding transport code DIAMANT2 are read from disk files. This code was developed in the same way as the two-dimensional transport perturbation code TP2 for rectangular geometry, therefore the code structure is nearly the same as in TP2. The code was designed to run under control of the modular code system KAPROS together with DIAMANT2 and other modules of this KArlsruhe PROgram System. Some results as well as input and output listings of sample calculations are included and explained in the report.

22485 Using MACSYMA to drive numerical methods to computer radiation integrals. Clark, B.A. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 230-231(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Because the emission of thermal radiation is characterized by the Planck emission spectrum, a multigroup solution of the thermal-radiation transport equation demands the calculation of definite integrals of the Planck spectrum. In the past, many approximate methods have been used with varying degrees of accuracy and efficiency. This paper describes how a symbolic algebra package, in this case MACSYMA is used to develop new methods for accurately and efficiently evaluating multigroup Planck integrals. The advantage of using a symbolic algebra package is that the job of developing the new methods is accomplished more efficiently.

22486 CAE - nuclear engineering analysis on work-station computers. Wessol, D.E.; Liebelt, K.H.; Merrill, B.J.; Nigg, D.W.; Wheeler, F.J. (Idaho National Engineering Lab., Idaho Falls). *Transactions of the American Nuclear Society;* **53**: 269-270(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Emergence of the inexpensive and widely available 32-bit work-station computer is revolutionizing the scientific and engineering computing environment. These systems reach or exceed threshold for many midscale nuclear applications and bridge the gap between the era of expensive computing: cheap people and the era of cheap computing: expensive people. Experience at the Idaho National Engineering Laboratory (INEL) has demonstrated the efficacy of this new computer technology. For the past 1 1/2 yr, a Hewlett-Packard 9000/540 32-bit multi-user microcomputer has been used to perform many calculations typical of a nuclear design effort. This system is similar with respect to performance and memory to such work stations as the SUN-3, HP-9000/32, or the Apollo DN-3000 that are available for under $20,000 for a fully configured single-user station. The system is being used for code development, model setup and checkout, and a full range of nuclear applications. Various one- and two-dimensional discrete ordinates transport codes are used on a routine basis. These include the well-known ANISN code as well as locally developed transport models. Typical one-dimensional multigroup calculations can be executed in clock times <10 min.

22487 Few-group analysis of current delayed-neutron data. Brady, M.C.; England, T.R.; Wilson, W.B. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **53**: 469-470(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Recent improvements in the knowledge of fission product yields and decay data have made it possible to study the yield of delayed neutrons per fission based on the summation of individual precursor properties. Earlier analyses of delayed-neutron data were based on 20, 105, and later 110 individual precursor nuclides. A current set of delayed-neutron data has been compiled and evaluated for 272 fission product nuclides that have been identified as delayed-neutron precursors based on energetics and/or measured emission probabilities. All 272 precursors are used in the current

analysis, although in most cases, ~90% of the total delayed-neutron yield can be accounted for by 30 to 40 of the more important precursors. In the present analysis, data for the 272 precursors are used to calculate delayed-neutron activity following a prompt irradiation of ^{233}U (fast fission). A least-squares analysis is performed on this exponentially decaying curve to produce few-group constants much in the manner in which Keepin et al. analyzed their experimental data in 1956. The analysis is performed for different few-group sets: 3, 6, 9, and 12 delayed-neutron groups and a comparison of the results is given.

22488 **Uncertainties in scientific measurements.** Holden, N.E. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **53**: 470-471(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

There has been increase emphasis on uncertainties in scientific measurements with the development of computerized programs to handle sensitivity analysis using variance-covariance matrices to treat correlations among data. In this presentation, the author addresses the general concern of systematic errors and review their application to specific problems of radioactive half-lives and the reactor parameters at thermal-neutron energies for the four fissile nuclides, ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu determined by the least-squares method.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 22513, 22569, 22571, 22572, 22574, 22575, 22582, 22583, 22585, 22586, 22591, 22609, 22610, 22837, 24336, 24337

22489 **(EPRI-NP—5012) Stress corrosion cracking test of expanded steam generator tubes: Final report.** Amoruso, G.V.; Schroeder, J.W. (Foster Wheeler Development Corp., Livingston, NJ (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920226.

Nuclear steam generators are experiencing stress corrosion cracking (SCC) within the mechanically rolled portion of the tube-to-tubesheet joints. The stress corrosion cracking is occurring as a result of high residual stresses caused by several things, including omitted steps, over or under rolling, laps in the rolling, and rolling in grossly oversized holes. A series of tests were performed to demonstrate that explosive tube expansion can lessen the susceptibility to stress corrosion cracking of improperly mechanically rolled joints by performing a post-rolling explosive expansion of the joint, and can make initial joints that are less susceptible to stress corrosion cracking than mechanically rolled joints. Results from polythionic acid stress corrosion tests indicated that none of the tubes mechanically rolled and then explosively re-expanded exhibited evidence of SCC, except for a kiss-rolled tube. Mechanically rolled tubes with no explosive re-expansion did exhibit SCC.

22490 **(FRADOC—9-7) Steam generator tube extraction.** Delorme, H. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). May 1985. 6p. (CONF-8505330—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751006.

From 11. annual meeting of the Spanish Physical Society; Barcelona, Spain (28 May 1985).

To enable tube examination on steam generators in service, FRAMATOME has now developed a process for removing sections of steam generator tubes. Tube sections can be removed without being damaged for treating the tube section expanded in the tube sheet.

22491 **(IAEA-TECDOC—390) Safety assessment of emergency electric power systems for nuclear power plants. A manual on the use of IAEA Safety Series No. 50-SG-D7: Emergency power systems at nuclear power plants.** (International Atomic Energy Agency, Vienna (Austria)). Sep 1986. 89p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87701516.

This paper is intended to assist the safety assessor within a regulatory body, or one working as a consultant, in assessing a given design of the Emergency Electrical Power System. Those non-electric power systems which may be used in a plant design to serve as emergency energy sources are addressed only in their general safety aspects. The paper thus relates closely to Safety Series 50-SG-D7 "Emergency Power Systems at Nuclear Power Plants" (1982), as far as it addresses emergency electric power systems. Several aspects are dealt with: the information the assessor may expect from the applicant to fulfill his task of safety review; the main questions the reviewer has to answer in order to determine the compliance with requirements of the NUSS documents; the national or international standards which give further guidance on a certain system or piece of equipment; comments and suggestions which may help to judge a variety of possible solutions.

22492 **(KFK—4160) Cyclic thermal loading of a Bree plate under constant tension.** Siebler, T.; Stamm, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Oct 1986. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751332.

A configuration of two rigidly coupled plates made of different materials is considered. Elastic ideal-plastic material behaviour is assumed. The plate configuration is subjected to cyclic thermal loading superimposed to a constant tensile load. In analogy to the so-called 'Bree-model' load combinations leading to elastic and shakedown behaviour, alternating plasticity and ratcheting are investigated.

22493 **Hanging core support system for a nuclear reactor.** Seidensticker, R.W.; Burelbach, J.P.; Kann, W.J.; Pan, Y.C.; Saiveau, J.G. (to Dept. of Energy, Washington, DC). US Patent 4,645,638. 24 Feb 1987. Filed date 26 Apr 1984. vp.

This patent describes a nuclear reactor having a guard vessel disposed in a ground connected foundation, an open top reactor vessel having an uppermost portion closed by a deck, a pool of sodium coolant in the reactor vessel, and a core disposed in the coolant. The improvement described here comprises an integral core support platform underlying the core, and integral linkage means including a flange lying directly on the uppermost portion of the reactor vessel and lying directly under the deck, a shirt depending downwardly from the flange adjacent but independent of the reactor vessel, and beams between the skirt and the support platform. The core support means operatively suspends the reactor core independently of the reactor vessel and the deck.

22494 **Support arrangement for core modules of nuclear reactors.** Bollinger, L.R. (to Dept. of Energy, Washington, DC). US Patent 4,643,868. 17 Feb 1987. Filed date 3 Nov 1983. vp.

This patent describes a support arrangement in combination with a nuclear reactor, which comprises at least one fuel cell module, at least one control drive mechanism, and at least one pressure vessel head. The support arrangement is located between the fuel cell module and the control drive mechanism and is supported by the pressure vessel head, the support arrangement comprising: a module support nut, engaged with the pressure vessel head and supported therefrom, including a downwardly depending screw threaded portion, and a shroud housing for the fuel cell module including a screw threaded portion engaged with the screw threaded portion of the support nut such that the shroud housing is suspended from the support nut and thus from the pressure vessel head, the module support nut and the shroud housing including a locking means for locking the nut and housing against relative rotation.

22495 **Heat dissipating nuclear reactor.** Hunsbedt, A.; Lazarus, J.D. (to Dept. of Energy, Washington, DC). US Patent 4,643,870. 17 Feb 1987. Filed date 21 Nov 1985. vp.

This patent describes a nuclear reactor containment comprising: reactor vessel disposed in a metal cavity located partially or completely below the surface of the earth in a cavity, a guard vessel, the reactor vessel being positioned within the guard vessel, a thick metal basemat beneath the reactor vessel and guard vessel and at the bottom of the cavity, means located below the basemat but

adjacent to it for feeding water to a porous media situated in a zone immediately underneath the basemat, the water being converted to steam when the temperature of the zone exceeds the boiling point of water, means for venting the steam so formed to the atmosphere, and means in contact with the basemat for supporting same and for conducting heat therefrom.

22496 **High level dynamic testing and analytical correlations for a small bore piping system.** Lindquist, M.R.; Anderson, M.J.; Severud, L.K.; Weiner, E.O. (Westinghouse Hanford Co., Richland, WA). pp 169-176 of Seismic engineering for piping systems, tanks and power plant equipment. Liu, T.H.; Chen, P.Y.; Patel, Y.A.; Ma, D.C. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

High-level dynamic testing of a prototypic insulated small bore diameter pipe system is described. The pipe system was supported by a minimum number of supports, with several combinations of supports and support locations tested. Load input consisted of a dynamic multi-frequency time history and sinusoidal loading at increasing acceleration levels until gross deformation of the system occurred. Very high level pipe damping was exhibited when plastic response occurred. Post-test analyses were performed to assess the structural loading and response of the pipe system under the dynamic load input. Several elastic and elasto-plastic analysis failure prediction methods were used, along with simplified inelastic analysis.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 22459, 23238

2204 Control Systems

REFER ALSO TO CITATION(S) 22526

22497 **(DEMO—83/19G) Optimal supervision and failure detection of dynamic technological systems.** Tzafestas, S.G. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1983. 39p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701498.

This report presents a review of the basic techniques developed over the recent years for the optimum supervision and detection/location of failures in dynamic technological systems such as nuclear reactors, aircrafts, etc. Regarding the optimum supervision problem the following policies are considered: optimum selection of supervision frequency, optimum supervision policies, optimum selection of sequential tests, and finally the effect of supervision capability upon the system availability. Regarding the optimum detection/location/identification of failures the following techniques are briefly presented: majority technique, failure sensitive filter technique, generalized maximum likelihood technique, output estimation error technique, dynamic redundancy technique with Luenberger observer, and finally jump processes technique. Some examples and comments on open problems for further research are also presented.

22498 **(NKA/LIT—85-1) Human component in the safety of complex systems. Summary report of the NKA/LIT programme 1981-1985.** Wahlstroem, B. (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). Feb 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750675.

The safety of nuclear power and other complex processes requires that human actions are carried though on time and without error. Investigations indicate that human errors are the main or an important contributing cause in more than half of the incidents which occur. This makes it important to try understand the mechanisms behind the human errors and to investigate possibilities for decreasing their likelihood. The present report presents an overview of the Nordic cooperation in the field of human factors in nuclear safety, under the LIT-programme carried out 1981-1985. The work was divided into six different projects in the following fields: human reliability in test and maintenance work; safety oriented organizations and company structures; design of information and control systems; new approaches for information presentation; experimental validation of man-machine interfaces; planning and evaluation of operator training. The research topics were selected from the findings of an earlier phase of the Nordic cooperation. The results are described in more detail in separate reports.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 22529, 22530, 22531, 22532, 22533, 22534, 22535, 22536, 22537, 22538, 22539, 22540, 22541, 22542, 22543, 22544, 22546, 22547, 22550, 23102, 23360, 23491, 24384

22499 **(INIS-mf—10527) Environmental radiometric.** Gaeta C, R. (Instituto de Asuntos Nucleares, Bogota (Colombia)). Jul 1986. 31p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701569.

This document stresses the importance of measuring the radioactivity of the environment in order to evaluate the radiological exposure of the population. The document emphasizes the necessity of detecting very low levels of radioactivity and the difficulties that it implies. The various components of its basis and the means for its reduction are mentioned. Information on the instruments required to identify and quantify the activities of the different radionuclides is given.

22500 **(INIS-mf—10534) Towards more realistic assessment of reactor accident consequences. A Nordic project.** Tveten, U. (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). Jul 1985. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750685.

The purpose of the Nordic project described in the report has been to improve the data base used in accident consequence assessments, and also to improve the assessment models in use in the Nordic countries. The following data related questions have been dealt with: Terrestrial transfer factors, the freshwater pathways, comparison of dynamic and static calculation models for fish, and the shielding effect of buildings. The work on terrestrial transfer factors has resulted in the generation of a Nordic fallout data bank. The following experimental investigations have been performed: Natural decontamination of roofs under summer and winter conditions, deposition in urban areas, and the filter effect of buildings. Various aspects of mitigating actions have also been examined. 122 refs.

22501 (INIS-mf—10580-Vol.1, pp 44-48) **Main principles of NPP project ecological expert investigation.** Dibobes, I.K.; Revina, S.K.; Glushkov, V.P. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

NPP project ecological expert investigation among the other objectives is to provide implementation of standards, rules and requirements as well as government decrees and international obligations of the USSR concerning the environment protection. The expert investigation takes into consideration both environment protection, regional, resources, ecological, demographic and economic aspects. The NPP siting and the local environment and resources state are estimated as well as the structure of utilization of the latter, the expected damage to the environment due to NPP construction and the measures directed towards the optimal using of natural resources. On the basis of the presented issues suggestions about NPP projects coordination with Goskomgidromet's institutions are given.

22502 (INIS-mf—10580-Vol.1, pp 63-68) **Radiation risk assessment for growing nuclear power system.** Zharnovetski, K. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The paper presents the results of assessment of radiation sources appearing with the development of nuclear power system

in comparison with the natural radiation sources. Evaluations of both local and global radiation risks are presented for NPP personnel, local and general population. The nuclear power system is shown to cause a long-term global contamination, almost uniform all over the world. But even at the highest possible power level and within the operation time period limited by the available uranium resources, this contamination won't result in any appreciable radiation danger for mankind. 12 refs.; 3 figs.; 1 tab.

22503 (INIS-mf—10580-Vol.2, pp 3-10) **Radiation and working conditions at NPP with WWER-440 and PWR.** Parkhomenko, G.M.; Egorova, M.S.; Vorob'ev, A.M.; Alferov, M.V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Comparative estimates of parameters characterizing radiation and working conditions at NPP with WWER-440 are presented. The assessment deals with the coolant radioactivity, gamma- and neutron radiation dose rates, surface and air contamination, radioactivity intake by the personnel, standard and mean individual dose commitment due to radiation exposure and other. 7 refs.; 4 tabs.

22504 (INIS-mf—10580-Vol.2, pp 11-19) **Dosimetric monitoring and specific features of radiation factors at Kozloduj NPP over 8 years operation.** Khitov, G.; Dichev, G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Organizing, methods and instrumentation for dosimetric and special technological monitoring to obtain current information about radiation conditions at Kozloduj NPP region are considered. The technological equipment state is analyzed, and the data of dosimetric and special technological monitoring within the NPP protective zone are presented for the period of 8 years operation, including the distribution of long-life radionuclides characteristic for WWER-440 reactor releases. The state of protective zones has been investigated as well as the feasibility of the personnel safety over NPP multi-years operation in an optimal regime. 5 refs.; 2 tabs.

22505 (INIS-mf—10580-Vol.2, pp 20-25) **Study of radiation safety during NPP operation.** Kapishovski, V.; Moravek, J.; Novak, S.; Pietrik, I.; Shtubnya, M. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The paper presents the results of a study carried out during NPP with WWER-440 start-up and first stage of operation. The study was concerned with: fission products identification in the primary coolant circuit; the delayed neutrons and noble gases detectors approbation; determination of gaseous releases radioactivity. The feasibility of such experimental studies under routine operation conditions has been demonstrated.

22506 (INIS-mf—10580-Vol.2, pp 26-35) **Evaluation of radiation impact on NPP personnel in GDR.** Raguze, Kh.O.; Pul'khejm, K.F.; Kryuger, F.V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The functioning of GDR state system for NPP personnel safety control is described. Taking two NPPs of 1830 MW(e) as an example, the activities within the scope of internal/external irradiation control programmes are demonstrated. The presented measurement results show the NPP personnel dose commitment to be within the accepted standards or much lower than the permissible limits. The collective dose commitments from the external irradiation are at the lowest part of world practice range. The major contribution into the dose commitment is obtained during fuel reloading, inspections and equipment maintenance operations. The contribution from the internal irradiation is negligible. 8 refs.; 4 figs.; 1 tab.

22507 (INIS-mf—10580-Vol.2, pp 47-52) **Radiation conditions during Novo Voronezh NPP start-up and commissioning.** Verkhovetskij, N.A.; Ivannikov, V.P.; Kozlov, V.F.; Kruglov, V.P.; Luzanova, L.M.; Posevin, A.T.; Slavyagin, P.D.; Kham'yanov, L.P. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The paper presents the major results of the radiation conditions study during start-up and commissioning of Novo Voronezh NPP 5-th unit. The WWER-1000 biological shield has shown to provide the design levels of neutron and gamma-radiation. The coolant activity and corrosion products deposition in the equipment do not exceed one tenth of the permissible values. As a result the personnel dose commitment is twice lower than at a NPP with WWER-440, while the radioactive releases into atmosphere and water are two orders of magnitude lower than the permissible values stated by SP-AEhS-79. 3 refs.; 2 tabs.

22508 (INIS-mf—10580-Vol.2, pp 109-115) **Statistic moment technique application for investigation of the sorption ability of the NPP gaseous release clean-up system.** Vilgelmova, L.; Dvorzhak, Z.; Tsejnar, F. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A new technique for the investigation of the noble gases dynamic adsorption in a radiochromatography clean-up system of the NPP gaseous releases is described. With the use of this method based on the theory of statistic moments some formulae were obtained for calculating the release curves for any noble gas radioactive isotope on the basis of an experimental or calculated curve for the corresponding stable isotope. Formulae are given for determining the NPP adsorbers capacity for radioactive noble gases, both in steady-state and periodic operation regimes. The suggested calculation techniques for the adsorbers assessment are applicable to any existing systems of gaseous releases clean-up from the radioactive noble gases. 10 refs.; 2 figs.

22509 (INIS-mf—10580-Vol.2, pp 116-124) **Iodine filter adsorbent (GA-I) ageing.** Zelinka, T.; Tsejnar, F.; Tomashek, M. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Laboratory study results on the static and dynamic ageing of GA-I adsorbent used in NPP iodine filters are presented. The efficiency decrease due to static ageing was found to be small (about 2% per year). But in case of the dynamic ageing it is high, amounting up to 40% per year of the air exposure. 7 refs.; 5 tabs.

22510 (INIS-mf—10580-Vol.2, pp 176-182) **Statistic regularities of radioactive noble gases standardized releases from NPPs.** Doroshenko, G.G.; Gusev, N.G.; Leonov, E.S.; Panchenko, S.V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The actual noble gases releases from a number of NPPs have been assessed. The obtained data are supposed to be used for establishing well-grounded routine and limiting dose rates for the regulation of NPP normal operation. The suggested system of the release standardization based on the monitoring and regulations ensures the practical realization of ALARA concept. 5 refs.; 4 figs.; 1 tab.

22511 (INIS-mf—10580-Vol.2, pp 183-197) **Calculations of activated corrosion products transport and radioactive wastes formation on a NPP.** Khorvat, L.G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A physical-chemical model and a calculation code RADSYS-RADTRAN have been developed for describing the radioactivity build-up on a NPP heat-exchange surfaces, with regard to the radionuclides and corrosion products solubility. On the basis of the theory the differences between various activated corrosion products transport models can be explained. The obtained results have shown pH value of the primary circuit water to be the essential factor affecting the corrosion products activity. Another part of the code takes into account the dynamics of the liquid wastes formation and allows to reveal the main factors determining their amount. 27 refs.; 23 figs.; 1 tab.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 22516, 22924

22512 **(AAEC/DR—23) Report of the Working Party on the conversion of HIFAR to low enrichment uranium fuel.** (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1986. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87701494.

This report states the effect on research reactor operations and applications of international and national political decisions relating to fuel enrichment. Technical work done in Australia and overseas to establish parameters for conversion of research reactors from High Enrichment Uranium (HEU) to Low Enrichment Uranium (LEU) have been considered in developing a strategy for HIFAR. The requirements of the research groups, isotope production group and reactor operating staff have been considered. For HIFAR to continue to provide the required facilities in support of the national need, it is concluded these should be no reduction of neutron flux.

22513 **(DEMO—84/1G) Emergency core cooling system for the Greek Research Reactor Democritus.** Papastergiou, C.; Mitsonias, C. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Feb 1984. 21p. (In Greek). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701616.

In this report the loss of coolant accident (LOCA) for the "Democritus" Research Reactor is considered. The time required to uncover the core, as well as the produced decay heat have been calculated. The emergency core cooling system (ECCS) which has been installed at the reactor is described and its characteristics are given. The installed ECCS is efficient in protecting the core from the LOCA consequences.

22514 **(EIR—606) Novel nuclear space heating system.** Seifritz, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1986. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701510.

Among the novel energy systems, being developed today, nuclear energy plays an important role. The space heating reactor system for small communities, proposed by the Swiss Federal Institute for Reactor Research, is presented and put in a larger frame of an energy philosophy.

22515 **(HEDL-SA—3510-FP) Analysis of the natural convective air cooling tests in the FFTF [Fast Flux Test Facility] interim decay storage vessel.** Guzek, J.C.; Stover, R.L.; Polzin, D.L.; Guttenberg, S. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76FF02170. 22p. (CONF-870307—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004434.

From ASME/JSME/ISES solar energy conference; Honolulu, HI, USA (22 Mar 1987).

This paper describes the analysis performed on tests in the FFTF Interim Decay Storage (IDS) facility to evaluate natural convective air cooling of large, sodium filled vessels. The test program was undertaken to support design of the emergency cooling system concepts, RVACS (GE's Radiant Vessel Auxiliary Cooling System) and RACS (Rockwell's Auxiliary Cooling System), proposed by General Electric and Rockwell for their innovative nuclear reactor designs. Results from the tests showed that natural convection effectively cooled the IDS up to the maximum tested sodium temperature of 700°F. A 3-dimensional computer simulation of the IDS tests was used to predict local heat transfer from which heat transfer correlations were inferred. The local dimensionless heat transfer correlations using either Grashof number or Graetz number provide a basis for extrapolating the IDS results to other large, annular natural convection cooling concepts such as the RVACS and RACS designs.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 22326, 22502, 22504, 22505, 22506, 22675, 23458, 23459, 23460, 23461, 23485, 23648, 24330

22516 **(DEMO—83/20G) Estimation of the consequences of the research reactor's hypothetical loss of coolant accident on the personnel of the Greek AEC.** Kollas, J.; Catsaros, N. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1983. 30p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701615.

In this report the consequences of the LOCA of the Greek Research Reactor on the Greek AEC's personnel are analyzed under conservative assumptions. This accident with very low possibility of appearance has nevertheless no trivial consequences and in order to mitigate them it was decided by the Reactor Safety Committee that the installation of a proper engineered safety system was necessary.

22517 **(EPRI-NP—4611-SR) Post-earthquake investigation: Planning and field guide.** Vasudevan, R.; Horstman, N.; Sliter, G.; Kassawara, R. (EQE, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1986. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920297.

The purpose of the PI Program is to document the performance during strong earthquakes of equipment, systems, piping, and structures in US and foreign industrial facilities. This information will be used mainly by US electric utilities to improve confidence in the safety of nuclear plants under earthquake conditions. It should be valuable also in mitigating the effects of earthquakes on all types of industrial facilities. This Planning and Field Guide describes how the program functions and the nature of the desired data.

22518 **(GKSS—86/E/32) Experimental investigations on load reduction in the pressure suppression system of boiling water reactors.** Aust, E. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751231.

For the load specification of pressure suppression systems in boiling water reactors the periodic pressure pulses from a condensation phenomenon, called chugging, are of great importance. The research indicates, that the chugging mechanism is mainly induced by the BORDA-effect at the sharp edge of the vent pipe outlet. Based on these insights, simple vent pipe outlet mitigators are developed and tested, which effect in a passive mode a significant reduction of the dynamic pressure pulses from this condensation phenomenon. The results also yield the proof of multivent effect, of time window for single chugging event occurrence at a multivent configuration and the assurance of the reproducibility of this dynamic condensation phase. With 55 figs., 2 tabs.

22519 **(HEDL-SA—3551-FP) Fuel-cladding chemical interaction correlation for mixed-oxide fuel pins.** Lawrence, L.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76FF02170. 20p. (CONF-861102—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005461.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

A revised wastage correlation was developed for FCCI with fabrication and operating parameters. The expansion of the data base to 305 data sets provided sufficient data to employ normal sta-

tistical techniques for calculation of confidence levels without unduly penalizing predictions. The correlation based on 316 SS cladding also adequately accounts for limited measured depths of interaction for fuel pins with D9 and HTq cladding.

22520 **(IFE/KR/E—86-004) Chernobyl accident. Course of events - health hazards - consequences.** Berg, J.O.; Christensen, G.; Lingjaerde, R.; Smidt Olsen, H.; Wethe, P.I. (Institute for Energy Technology, Kjeller (Norway)). Oct 1986. 26p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750695.

In connection with the Chernobyl accident the report gives a description of the technical features of importance to the accident, the course of events, and the estimated health hazards in the local environment. Dissimilarities in western and Sovjet reactor safety philosophy are dealt with, as well as conceivable concequences in relation to technology and research in western nuclear power programmes. Results of activity level measurements of air and foodstuff, made in Norway by Institute for Energy Technology, are given.

22521 **(INIS-mf—10247) Assessment of the fire hazard in nuclear facilities.** Liemersdorf, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 33p. (In German). (CONF-8611107—5). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751204.

From 10. GRS expert's meeting on results of new safety analyses; Koeln, F.R. Germany (12 Nov 1986).

The fire protection for conventional buildings and in the industrial area is essentially an empirical discipline. But, for nuclear facilities, the objectives of fire protection are higher than those used in the conventional field. Consequently, it is necessary to develop methods to strengthen or to supplement the empirical evaluation methods on a scientific basis. This paper describes the method for fire hazard analysis developed for this purpose and presents some important results of its application to nuclear power plants. The analysis has the objective, on the one hand, of quantifying the risk contribution of a fire to the overall risk of a nuclear power plant and, on the other, to gain a balanced concept of individual fire protection measures. The results show that the fire risk contribution is relatively small in comparison with the contribution of other events and does not dominate the overall risk of the plant. This justifies the fire protection concepts of the facilities which have been examined. Additionally, it can be shown that further optimization is possible. The analysis method, which has been developed to evaluate the fire hazards of nuclear power plants is also expected to be applied to other nuclear facilities in future. In principal, though, the method may also be applied to the conventional field.

22522 **(INIS-mf—10323) Further development of KAVERN and code development on gas generation from the containment basement during concrete decomposition.** Schwarzott, W.; Artnik, J.; Hassmann, K.; Kemner, H.; Stuckenberg, X. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Apr 1983. 108p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751211.

The events during the melt/concrete interaction, e.g. the shape of the cavity and the mass and energy of gases released to the containment atmosphere can be analysed by the computer code KAVERN. In case of basaltic conrete sump water contacts the melt surface after 7 hours. Overpressurization of the containment is calculated to occur after appr. 5 days. For different paths out of the reactor cavity to the containment atmosphere STROMI calculates the mass flow of the gases released during melt concrete interaction. Results show max. temperatures up to 1200/sup 0/C which is well above the self ignition temperature of H/sub 2/.

22523 **(INIS-mf—10329) Evaluation of the Chernobyl reactor accident (as of May 30, 1986).** Franzen, F.L. (Gesellschaft fuer Energiewissenschaft und Energiepolitik e.V. (GEE), Bonn (Germany, F.R.)). Jun 1986. 25p. (In German). (CONF-8606285—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751199.

From Information meeting on the Chernobyl reactor accident and the resulting radioactive exposure in the Federal Republic of Germany; Bonn, F.R. Germany (4 Jun 1986).

Compact presentation of information, as available on May 30, 1986, including the design of the Chernobyl reactor, the presumed course of events and causes of the accident, and radiological consequences.

22524 **(INIS-mf—10332) Risk analyses of accidents in nuclear power plants.** Heuser, F.W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 30p. (In German). (CONF-8611107—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751200.

From 10. GRS expert's meeting on results of new safety analyses; Koeln, F.R. Germany (12 Nov 1986).

After discussing tasks and objectives of risk analyses main results of system and accident event tree analysis of the German Risk Study, Phase B, are summarized briefly. The second part deals with the analysis of core melt accidents. Hereto investigations on the hydrogen problem and investigations performed on containment venting after core melt are discussed more detailed. Based on these results some proposals for counter measures are discussed which are adequate to restrict potential damages from an accident mostly to the plant.

22525 **(INIS-mf—10333) Recent results of fission product release from the core and from the reactor containment after accidents.** Friederichs, H.G.; Schroedl, E. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 21p. (In German). (CONF-8611107—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751201.

From 10. GRS expert's meeting on results of new safety analyses; Koeln, F.R. Germany (12 Nov 1986).

The contribution describes results of calculations concerning the release of radioactive material. These calculations have been perforemd when preparing phase B of the German Risk Study and have been compared with corresponding results of phase A. It has become evident that conservative assumptions could be reduced by a more detailed modelling in the calculations for phase B and that recent results are approximately one order of magnitude lower than those obtained for phase A. The second part discusses how the release caused by the accident in the Chernobyl-reactor can be evaluated when taking into account the analysis performed hereto. A comparison between releases measured in Chernobyl and the calculated potential releases reveals fundamental differences in both the quantity and the nuclide specific composition of the released material.

22526 **(INIS-mf—10334) Reliability studies for safety systems and comparison with evaluation of operating experiences.** Hoertner, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 35p. (In German). (CONF-8611107—3). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751202.

From 10. GRS expert's meeting on results of new safety analyses; Koeln, F.R. Germany (12 Nov 1986).

Comprehensive and detailed reliability analyses for safety systems of nuclear power plants are performed within risk studies and probabilistic safety analyses. The main taks of these analyses are to prove whether the safety concept is well balanced or to possibly show improvements. For achieving realistic assessments with the reliability analyses more intensive evaluation of field experience is performed. The first part discusses the prerequisites necessary for the reliability analyses, emphasizing the reliability data. The second part deals with the results of the reliability analyses performed within Phase B of the German Risk Study. A comparison is made with the direct evaluation of field experience in the German Precursor Study. Finally, the current program is briefly described concerning reliability analyses performed for important safety-related systems of nuclear power plants which have been in operation for several years; plant-specific field experience will be evaluated to support these investigations.

22527 **(INIS-mf—10335) Report of the Federal Ministry for the Environment, Protection of Nature and Reactor Safety, on the reactor accident of Chernobyl, its repercussions, and precautions taken or to be taken - including addenda.** Petroll, M. (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 3 Jul 1986. 222p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87751336.

Chernobyl-Info.; No. 2.

Apart from the report of the Federal Ministry for the Environment, the publication contains the following chapters: 1) Monitoring of environmental radioactivity; 2) analysis of propagation processes; 3) control and measuring points of the Federal Laender to monitor environmental radioactivity; 4) determination of the local dose rate; 5) concentration of radioactivity in air and soil (graphs); 6) up-to-date knowledge of events, measures; 7) nuclear power plants in the Federal Republic of Germany (review of technical safety); 8) interim report of the Committee on Reactor Safety - Reaktorsicherheitskommission - for preliminary evaluation; 9) interim report of the Committee on Radiation Protection - Strahlenschutzkommission - for assessment and evaluation of the effects.

22528 **(INIS-mf—10352) Incident guidelines for nuclear power stations of the FRG - an example illustrating the degradation of safety standards for nuclear power plants. Critical comments presented on the occasion of an official hearing of experts convened by the Parliamentary Committee of Internal Affairs of the German Bundestag.** (Institut fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.); Institut fuer Angewandte Oekologie, Darmstadt (Germany, F.R.). Projektgruppe Reaktorsicherheit). 1984. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751220.

Oeko-Institut Freiburg. Werkstattreihe.; No. 8.

The 'Guidelines for the Assessment of the Design of Nuclear Power Plants Against Incidents', i.e. the Federal German Incident Guidelines, have been the subject of an official hearing of experts before the Committee of Internal Affairs of the German Bundestag on February 22, 1984. The report in hand presents the official invitation to the meeting, the list of questions posed, written statements given by critics, and an appendix with the full text of the Incident Guidelines, as of August 12, 1983.

22529 (INIS-mf—10580-Vol.1, pp 9-14) **CMEA country-members cooperation in radiation safety during 1976-1981.** Bil'bao, A.; Shtregober, V. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A summary of nuclear power plant radiation safety activities within 1976-1980 is presented. Major results of scientific and engineering cooperation between CMEA country-members in this field are reviewed. A number of radiation safety tasks is suggested to be added to the list approved in 1978 by the CMEA permanent commission Atomenergo, as follows: development of the environment protection requirements both under normal operation conditions and during accidents on Nuclear power plants, Nuclear heat supply plants, Nuclear heat-electricity supply plants; development of technical and organizational measures for the personnel exposure reduction during repair and fuel reloading operations at NPP; estimates of radiation conditions at the NPP site location both under normal operation conditions and during accidents.

22530 (INIS-mf—10580-Vol.1, pp 15-23) **Radiation safety of commercial NPP with WWER-440.** Dichev, G.; Khitov, G.; Fisher, R.; Shrajter, V.; Ryuger, G.; Beskrestnov, N.V.; Grishmanovskij, V.I.; Kozlov, V.F.; Fenk, K.; Tsarakh, J. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The CMEA country-members joint reviewing report presents data based on NPP with WWER-440 operation experience which give evidence that both personnel and population radiation safety has been reliably ensured. The individual external dose commitment for the most part of personnel did not exceed 10% of the annual permissible value, while the collective dose normalized to the produced electricity did not exceed 0.01 manxSv/(MWxyear) that is less than on the similar NPPs in the USA and FRG. The annual release of radioactive gases and aerosols did not exceed the permissible design levels. The annual radioactive materials dumping with water leakages (except tritium) is negligible. There is practically no impact from these NPPs on the environment. 7 refs.; 4 tabs.

22531 (INIS-mf—10580-Vol.1, pp 24-30) **New sanitary regulations for NPP design and operation, SP-AEhS-79.** Gusev, N.G. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Basing of new 'Sanitary regulations for NPP design and operation', SP-AEhS-79 is given and experience of their application at the design centers and operating NPPs in the USSR is observed. New dose quotas and maximum permissible radioactive aerosols releases, stated by SP-AEhS-79 are discussed as well as the permissible population dose commitment under the conditions of the maximum credible accident. Some difficulties and contradictions arising during the new 'Sanitary regulations' employment are analyzed and the ways to thier elimination outlined. On the basis of the CMEA country-members opinions on the SP-AEhS-79 the feasibility of a common regulation document for these countries has been considered. 4 refs.; 8 tabs.

22532 (INIS-mf—10580-Vol.1, pp 31-36) **Regulation principles for NPP radionuclide releases into atmosphere.** Teverovskij, E.N.; Artemova, N.E.; Bondarev, A.A. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The present day views on the permissible levels of atmosphere contamination by NPP radioactive releases are observed. Methods for determination of the NPP effluents permissible concentrations are described for all their possible paths to people irradiation within time intervals. Calculation techniques for maximum permissible releases (MPR) are considered for different type atmosphere contamination sources as well as those sources classification. Accounting for the atmosphere background contamination is also described in connection with MPR determination. A system of regulation criteria and measures has been realized with the objective of the atmosphere protection against contamination. 5 refs.; 1 tab.

22533 (INIS-mf—10580-Vol.1, pp 49-58) **Providing of personnel and population radiation safety during possible NPP accidents in the USSR.** Nevskij, V.P.; Beskrestnov, N.V.; Kozlov, V.F.; Filatov, A.S.; Kham'yanov, L.P. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The report describes the following major aspects of radiation safety ensuring in the USSR: methodics base and structure of plans, radiation accident classification with respect to radioactivity release amounts and distribution both within and beyond NPP, planned measures for population protection depending on accident type and class, the ways of these measures realization. 5 refs.; 1 fig., 1 tab.

22534 (INIS-mf—10580-Vol.1, pp 59-62) **Individual protection of NPP personnel.** Koshcheev, V.S.; Gol'dshtejn, D.S.; Chetverikova, Z.S. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Specific features of NPP personnel individual protection are considered, mainly with respect to maintenance and repair works on various type reactors. The major concern is given to the selection and application reglamentations of the individual protection system (IPS), employment of sanitary locks, the organization of individual protection under the conditions of a heating microclimate.

The ways are specified to the development and introduction of the most effective IPS and improvement of the entire NPP personnel individual protection system with respect to providing the necessary protection effect for maintaining high working capability of the personnel and minimizing the IPS impact on human organism functional systems. The accumulated experience in the personnel individual protection can be applied during construction and operation of NPP's in CMEA member-countries. 5 refs.

22535 (INIS-mf—10580-Vol.1, pp 69-78) **Expected dose commitment for the USSR population with planned nuclear power system development.** Il'in, L.A.; Pavlovskij, O.A. 1983. (In Russian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112. (CONF-8205317—Vol.1).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

On the basis of calculated and actual data on NPP with WWER and LWGR gas, aerosole and liquid radioactivity releases an estimate has been made of individual and collective dose commitment normalized to 1 MW of electric power. Both external and internal irradiation and all the possible parts of radiation impact from the released radionuclides on human organism were considered. For the planned in the USSR commissioning of 200 GW(e) NPPs up to year 2000 the equivalent collective dose commitment for the whole country population has been shown to amount to only 22 manxSv per year that is less than 0.01% from the natural radiation background. 8 refs.; 5 figs.; 4 tabs.

22536 (INIS-mf—10580-Vol.1) **Radiation safety of Nuclear Power Plants operation. Book 1. Collection of papers from CMEA scientific-engineering conference.** (Sovet Ehkonomicheskoj Vzaimopomoshchi, Moscow (USSR). Postoyannaya Komissiya po Ispol'zovaniyu Atomnoj Ehnergii v Mirnykh Tselyakh). 1983. 141p. (In Russian). (CONF-8205317—Vol.1). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780112.

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Separate abstracts were prepared for the individual papers in this conference. (JDB)

22537 (INIS-mf—10580-Vol.2, pp 36-41) **Personnel dose commitment during repair works.** Peters, R.; Shloskhauehr, K. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Methods of accounting for radiation dose commitment during repair works are described (Table of specific operations). The results of technical supervision (before 1980) are discussed. Conclusions are made about necessity of further technical measures development for radiation dose commitment reduction. 2 tabs.

22538 (INIS-mf—10580-Vol.2, pp 42-46) **Radioactive aerosols intake through inhalation during repair works on NPP with WWER-440.** Alferov, M.V.; Egorova, M.S.; Tal'yanskij, E.D.; Tsov'yanov, A.G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

On the basis of accumulated statistic data on radioactive aerosols characteristics (concentrations, isotopic composition, dispersion) and by means of individual probes and the method of smears from noze the evaluation of these aerosols intake through inhalation during repair works on NPP with WWER-440 has been made. The inhalation intake was shown to depend considerably on the nature of the repair operation and application of individual protection devices. The intake activity can vary within a wide range from 3.7 up to 7400 Bq/day. 4 refs.; 3 tabs.

22539 (INIS-mf—10580-Vol.2, pp 58-63) **Calculation analysis of radiation safety in NPP designing.** Baranaev, Yu.D.; Suvorov, A.P. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An algorithm and computation code are described for predicting radiation conditions both within a NPP building and at the site. Radionuclide releases from the plant airtight volumes during normal operation are considered as well as during accidents. The code library includes data on 40 most radiobiologically dangerous isotopes and allow their number enlargement up to 100. 2 figs.

22540 (INIS-mf—10580-Vol.2, pp 64-68) **Plant lay-out impact on personnel radiation safety at NPP with WWER.** Alferov, M.V.; Egorova, M.S.; Sayapin, N.P. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

It is shown that personnel radiation exposure reduction has been achieved to a considerable degree due to separation of zones with free and restricted regimes. The results of a hygienic investigation have confirmed the validity of the plant lay-out design with respect to sanitary inspection, stationary and movable air-locks, providing dedicated rooms for deactivation and equipment repair and so on. 5 refs.

22541 (INIS-mf—10580-Vol.2, pp 69-72) **Basic approach to radiation safety in Cuba.** Domenes, A.; Pubil'ones, M.Eh. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Guiding documents are described intended to provide the necessary radiation safety levels during the first Cuban nuclear power plant operation. The main criteria for monitoring system are discussed.

22542 (INIS-mf—10580-Vol.2, pp 73-77) **On the role of ventilation and air clean-up in the radiation safety ensurance for NPPs with WWER-1000.** Kochetkov, O.A.; Proskurovskij, F.Ya.; Sayapin, N.P.; Tal'yanskij, E.D.; Filatov, A.S. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The main radiation hygiene principles are considered for ventilation of NPPs with WWER-1000 with airtight shell as well as the design solutions for the ventilation and air clean-up systems of the reactor premises. On the basis of the major gas and aerosol radiation release sources assessment and experience of Novo Voronezh NPP 5-th unit operation the efficiency of the ventilation and air clean-up systems design has been demonstrated from the viewpoint of the personnel safety and impact on the environment.

22543 (INIS-mf—10580-Vol.2, pp 78-82) **Hygiene principles for establishing the practical reference levels of the personnel radiation safety ensurance.** Bad'in, V.I.; Kopaev, V.V.; Naumov, I.S. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

As the main hygiene principle for establishing the reference radiation exposure levels their conformity with NCRP and ICRP concept of decreasing the dose commitments to as low level as possible is considered. It is emphasized that a formal dose commitment fixing should be absolutely excluded because there are some reasons to expect its following to the logarithmic normal distribution law. In this connection probabilistic methods for the personnel radiation safety conditions evaluation are applied as well as for establishing the practical reference levels of the ionizing radiation. Relations for the reference exposure levels calculation are given. 5 refs.

22544 (INIS-mf—10580-Vol.2, pp 83-90) **Radiation monitoring preparation and carrying out during start-up of the 1st unit of Paks NPP.** Chom, D.; Nad', M.; Ronaki, J.; Rosha, G.; Virag, E. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

On the the basis of the monitoring data comparison with the design values evaluations of the shielding efficiency for the controlled zone have been made at various power levels specified for both physical and power start-up. The developed technique for the dose commitment evaluation with the use of a computer allows to compare permanently the results with the monitoring data obtained during operation. 3 figs.; 4 tabs.

22545 (INIS-mf—10580-Vol.2, pp 91-97) **Code complex for the safety systems reliability assessment.** Kvint, U.; Tsabka, G. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Definitions for the system structure, failure tree and mathematical calculation base are given, codes for the technical systems reliability calculation are described. The scope of the code complex applicability is demonstrated on examples. 2 figs.

22546 (INIS-mf—10580-Vol.2, pp 98-102) **Investigation of chemical behaviour of the fission products during accidental releases.** Tepfer, V.; Oppermann, Kh. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A system of computation codes is described that has been used for quantitative calculations of the gas phase composition within the voids of fuel elements after a certain time of normal operation. This data can be used for the accident analysis. The computation time on BEhSM-6 type computer is 60s. A review of literature on this issue is given. 4 refs.

22547 (INIS-mf—10580-Vol.2, pp 125-136) **Classification of accidents on NPP with WWER.** Grishmanovskij, V.I.; Kozlov, V.F.; Luzanova, L.M.; Tsajsler, P.; Mishak, I.; Moravek, J.; Shtubnya, M. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A final report is presented considering the results of a joint work of CMEA member countries on the radiation safety of NPPs with WWER type reactors. The earlier adopted by CMEA member countries classification of accidents is modified on the basis of new data on the fission products accidental releases, on the coolant leakages and on the radiation conditions both within and outside the NPP with regard to the efficiency of the protecting and localizing systems actuated during an accident. In addition an accepted in the USSR classification is described that takes into consideration the limits of the radioactive release spreading: local, regional or global as well as the definitions of the maximum design and hypothetical accidents used at the stage of the NPP engineering design. 6 refs.; 4 figs.

22548 (INIS-mf—10580-Vol.2, pp 137-140) **Basing of a complex design measures for protection against fire.** Kryuger, V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Fire impact on NPP radiation safety is analyzed. The general industry requirements to the protection system against fire are shown to be insufficient for NPPs. A complex of protection measures against fire is suggested that should be taken into account in the NPP designs.

22549 (INIS-mf—10580-Vol.2, pp 141-148) **Principles of the environmental protection during accidents on NPPs.** Myunkhov, V.; Kryuger, F. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The tasks for NPP radiation safety ensurance are identified. The joint activities of the NPP personnel, of the authorities giving permition for the plant operation and of the local institutions in realizing the measures preventing the radiation impact of accidents on the environment are described. The need for connection between the local institutions and plant personnel is emphasized. 1 fig.; 1 tab.

22550 (INIS-mf—10580-Vol.2, pp 149-157) **Radiation impact of accident at a unificated NPP with WWER-440.** Kozlov, V.E.; Pavlenko, V.I. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The report presents data on radioactive noble gases and iodine-131 releases to the environment and in the NPP premises during type II(MDA) and type I(HA) accidents. The data have been obtained in accordance with the classification of WWER accidents with primary circuit coolant leakages adopted by CMEA member countries, 'The sanitary rules of NPP designing and operation' and 'General points of NPP safety ensurance' used in the USSR, and with the initial design data in the form of calculation result tables and comments. The possible dose commitments via whole body external exposure and internal exposure of the thyroid gland due to iodine-131 inhalation at the first stage after an accident, both for the personnel and the limited group of population (Especially children) at the site boundary (2-3 km from the plant) are presented either. The dose equivalent for a child thyroid gland in case of MPA is shown to be not greater than the permissible one (0.30 Sv), in case of a HA some measures for the population and personnel protection are needed. 10 refs.; 5 tabs.

22551 (INIS-mf—10580-Vol.2, pp 158-169) **BETL-B code for calculation of the fuel element cladding temperature during accidents.** Tsajsler, P. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A mathematic model and a code for calculation of the fuel element cladding temperature during accidents with coolant leakage are described. The computation results are given for different basic assumptions about the film boiling on the fuel element surface. 4 refs.; 6 figs.; 1 tab.

22552 **(INIS-mf—10580-Vol.2) Radiation safety of Nuclear Power Plants operation. Book 2. Collection of papers from CMEA scientific-engineering conference.** (Sovet Ehkonomicheskoj Vzaimopomoshchi, Moscow (USSR). Postoyannaya Komissiya po Ispol'zovaniyu Atomnoj Ehnergii v Mirnykh Tselyakh). 1983. 201p. (In Russian). (CONF-8205317—Vol.2). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113.

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Items within the scope of EDB have been entered separately into the data base. (ACR)

22553 **(INIS-mf—10585) Radiation and health hazards. Chernobyl in perspective.** (Royal Swedish Academy of Engineering Sciences, Stockholm). 1986. 44p. (In Swedish). (CONF-8608133—). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750699.

From Conference on radiation and health hazards: Chernobyl in perspective; Stockholm, Sweden (28 Aug 1986).

At this symposium, arranged by the Royal Swedish Academy of Engineering Sciences, the health consequences in Sweden of the Chernobyl accident were reviewed. (L.E.).

22554 (INIS-mf—10585, pp 1:1-16) **Radiation and cancer incidence - some reflections on the Swedish cancer panorama.** Larsson, L.G. (Regionsjukhuset, Umeaa Sweden). 1986. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750699. (CONF-8608133—).

From Conference on radiation and health hazards: Chernobyl in perspective; Stockholm, Sweden (28 Aug 1986).

The knowledge concerning radiation-induced cancer is reviewed. The average risk in Sweden from the Chernobyl fallout is compared to the risks from other radiation scources (which is dominated by radon in dwellings), and a mean value for the next 50 years is 4 cases of cancer/year which should be compared to 1400 cases from other sources. (L.E.).

22555 (INIS-mf—10585, pp 4:1-9) **Radiation and cancer in Sweden after the Chernobyl accident.** Walinder, G. (Sveriges Lantbruksuniversitet, Uppsala Sweden. Enheten foer radiologisk onkologi). 1986. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750699. (CONF-8608133—).

From Conference on radiation and health hazards: Chernobyl in perspective; Stockholm, Sweden (28 Aug 1986).

A popular description is given of how cancer may be caused by radiation and of the dose-response connection, and the statistical model of the dose-response relation. The article ends up in a discussion of the estimates of the number of cancer cases in Sweden caused by the Chernobyl accident. (L.E.).

22556 (JAERI-M—86-009, pp 27-37) **Thermal-hydraulic analysis of light water reactor severe core damage accident.** Tanabe, Fumiya; Muramatsu, Takeshi; Suda, Tohru. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

A computer code SEFDAN has been developed in JAERI for analysis of severe fuel damage process under core uncovery condition such as occurred in TMI-2 accident, and applied to analyses of severe fuel damage test (SFD-ST and SFD 1-1 tests) in the PBF reactor. Further, the degree of the core damage in the TMI-2 accident has been evaluated. The major influential factors to the fuel behavior under the core uncovery are height of the dryout level of fuel rods (core froth level), heat transfer in the uncovered region, and the metal-water reactions of the cladding material. The froth level is calculated in the SEFDAN code by solving conservation equations for mass and energy of the two-phase mixture. Above the froth level, flow rate and the temperature of gas flow are calculated in taking account of steam consumption and hydrogen generation due to metal-water reaction. Heat transfer in the uncovered region consists of convection mode and radiation mode. The convective heat transfer is calculated with experimental correlations, which are chosen in accordance with newly developed convection flow regime map. The calculated results of the PBF.SFD-ST and 1-1 tests are in good agreement with experimental ones. Further the calculated result of the TMI-2 core damage is also in good agreement with the result of core examination by TV camera and ultrasonic core topography system.

22557 (JAERI-M—86-009, pp 38-50) **SIMMER code and its applications to LMFBR safety analysis.** Kondo, Satoru. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Among various computer codes used in the safety analysis of liquid-metal fast breeder reactors (LMFBRs), the SIMMER code heavily utilized at the PNC is described in this document, including: the neutronics and fluid-dynamics models, and methods; examples of code application to LMFBR accident analyses; the current status of an experimental validation program; and the status of a vectorization study.

22558 (LA-UR—86-4389) **Computational methods of the Advanced Fluid Dynamics Model.** Bohl, W.R.; Wilhelm, D.; Parker, F.R.; Berthier, J.; Maudlin, P.J.; Schmuck, P.; Goutagny, L.; Ichikawa, S.; Ninokata, H.; Luck, L.B. (Los Alamos National Lab., NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Protection et de Surete Nucleaire). 1987. Contract W-7405-ENG-36. 16p. (CONF-870424—1). NTIS, PC A02. File Number DE87005943.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

To more accurately treat severe accidents in fast reactors, a program has been set up to investigate new computational models and approaches. The product of this effort is a computer code, the Advanced Fluid Dynamics Model (AFDM). This paper describes some of the basic features of the numerical algorithm used in AFDM. Aspects receiving particular emphasis are the fractional-step method of time integration, the semi-implicit pressure iteration, the virtual mass inertial terms, the use of three velocity fields, higher order differencing, convection of interfacial area with source and sink terms, multicomponent diffusion processes in heat and mass transfer, the SESAME equation of state, and vectorized programming. A calculated comparison with an isothermal tetralin/ammonia experiment is performed. We conclude that significant improvements are possible in reliably calculating the progression of severe accidents with further development.

22559 (NILU-TR—7/86) **Air radioactivity at selected stations in Norway after the Chernobyl reactor accident.** Pacyna, J.M.; Semb, A.; Johansen, O.; Saltbones, J. (Norsk Inst. for Luftforskning, Kjeller). Sep 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750895.

The activities of /sup 103/Ru, /sup 131/I and /sup 137/Cs in air and in precipitation samples at some Norwegian stations after the Chernobyl reactor accident are reported. Two periods of increased radioactivity occured. In the first period the total airborne radioactivity increased up to three orders of magnitude over the normal background. As expected /sup 131/I was the predominant radionuclide in the plume from Chernobyl. The measurements show that a few stations with contionuous monitoring of radioactivity in air would have been sufficient to detect the transport into Norway of radioactive material from the accidental release at Chernobyl.

22560 (NUREG—1137-Suppl.6) **Safety Evaluation Report related to the operation of Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1987. 122p. NTIS, PC A06/MF A01 - GPO. File Number TI87900567.

In June 1985, the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-1137) regarding the application of Georgia Power Company, Municipal Electric Authority of Georgia, Oglethorpe Power Corporation, and the City of Dalton, Georgia, for licenses to operate the Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425). This sixth supplement of NUREG-1137 provides recent information regarding resolution of some of the open and confirmatory items that remained unresolved at the time the Safety Evaluation Report was issued. These areas are performance testing, reactor cooling hydraulics, loose parts monitoring, and electric power systems.

22561 (NUREG/CP—0076, pp 15-32) **Structural reliability of containment structures - CANDU nuclear power plants.** Osman, M.A. (Ontario Hydro, Toronto). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper identifies three types of structural failure for the containment, based on the definition of failure as the termination of the ability to perform a required function. It describes a proposed

methodology for modelling structural reliabilities for containment and methods to improve such reliabilities through design, specifications and construction controls.

22562 (NUREG/CP—0076, pp 33-42) **Modelling of a negative-pressure, filtered-vented containment system as part of a probabilistic safety evaluation.** Dinnie, K.S. (Ontario Hydro, Toronto). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The modelling of a negative-pressure, filtered-vented containment system as part of the Darlington Probabilistic Safety Evaluation is addressed. The approach taken to containment modelling has been influenced by both the containment design and the scope of the study as a whole. This paper describes the development of the containment event tree and outlines its role in the overall containment analysis.

22563 (NUREG/CP—0076, pp 43-54) **Secondary containment building performance in severe accidents.** Denning, R.S.; Cybulskis, P. (Battelle Columbus Div., OH). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

In evaluating the potential consequences of severe accidents in nuclear power plants, principal emphasis has been on the performance of the primary containment building. For the most severe accident scenario in which the primary containment may be predicted to fail early in the accident or in which containment is bypassed, the behavior of a secondary containment building could be important in reducing the potential consequences of the accident. In this paper, some example analyses are presented in which the behavior of the secondary building was considered. The predicted effect on accident consequences are discussed. Key uncertainties regarding the analysis of secondary containment performance are identified and recommendations are made to improve future analyses.

22564 (NUREG/CP—0076, pp 55-68) **Risk analyses of the Ringhals plants: containment behavior and filtered vent.** Espefaelt, R.; Gunsell, L.; Loewenhielm, G.; Kaiser, G.; Fulford, P.J. (Swedish State Power Board, Vaellingby, Sweden). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The role of containment behavior in the risk assessment for the Ringhals BWR unit and three PWR units is discussed. Brief descriptions of the plants and their containment systems are given, and the possible failure modes investigated in the analysis are described. Presently visualized strategy emphasizing both hardware and procedural measures for meeting accident management requirements is briefly outlined.

22565 (NUREG/CP—0076, pp 69-84) **Containment integrity is a major part of KKL-safety systems PRA.** Schaub, T.; Haenni, H.P. (Kernkraftwerk Leibstadt AG, Switzerland). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Assuming a hypothetical accident with core meltdown, hardware changes are described with which the containment integrity of the Leibstadt NPP can be secured. Venting of the containment through the standby gas treatment system is initiated manually. This system is called COSA (Containment Safeguard). The pressure margins for the containment failure are determined and compared with the design pressure. The expected population doses without and with COSA are presented. On the basis of a fault tree PRA the gain in overall safety is derived. A cost-benefit analysis on the three safety levels leads to a general formula as a proposal to minimize the ratio of investment cost to safety gain.

22566 (NUREG/CP—0076, pp 85-96) **Analysis of strategies for containment venting in case of severe accidents.** Bracht, K.; Tiltmann, M. (Gesellschaft fur Reaktorsicherheit, Cologne, West Germany). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

During a core melt accident, a pressurization of the containment has to be expected, which could lead to a failure of the containment due to overpressurization. This failure mode is expected to be the most likely one for large dry containments under accident conditions. Also during a core melt accident, a large quantity of hydrogen may be generated, giving the potential of a loss of containment integrity due to violent hydrogen combustion. Timely venting of the containment atmosphere can prevent overpressurization and may perhaps make the hydrogen situation in the containment less severe. This paper discusses the thermodynamic consequences of different vent strategies for a large German PWR during core melt accidents.

22567 (NUREG/CP—0076, pp 97-126) **Evaluation of uncertainties in risk emanating from a number of severe accident issues.** Benjamin, A.S.; Boyd, G.R.; Murfin, W.B.; Kunsman, D.M. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

A study has been performed to estimate, for a particular pressurized water reactor, the uncertainty in risk associated with a number of key phenomenological issues. A second objective was to distinguish the individual importance of the various issues as contributors to the overall uncertainty in risk. The issues considered touched upon the areas of system behavior, containment loading, containment performance, and fission product source term behavior. It was found that direct heating was the most important issue for the plant in question (Surry Unit 1). Other important containment issues included the potential for hydrogen burning during direct heating scenarios and the containment failure pressure.

22568 (NUREG/CP—0076, pp 129-138) **New Belgian position on containment leakage testing.** De Boeck, B. (Association Vincotte, Bruxelles, Belgium). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The containment leakage testing requirements (up to now 10 CFR 50 App. J) have recently been reevaluated in Belgium. The criterion for type A tests at half the accident pressure has been strengthened, but the periodicity has been relaxed. New overall leakage test at very low overpressure have been required after each extended cold shutdown period. A few items of the procedure for type A tests have been modified. It is felt that the new requirements improve the safety but also lower the burden of the containment leakage tests. Experimental results from tests performed in 1985 at Tihange reactor and Doel unit 3 are presented.

22569 (NUREG/CP—0076, pp 139-152) **Alternative containment integrity retesting requirements and local leakage calculation methods.** Glover, J.P. (Commonwealth Edison Co., Chicago, IL). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper discusses two topics on containment leakage testing. First, the Minimum Path method of calculating leakage from multi-valve isolation systems is examined. It will be shown that this method is overly conservative relative to its intended purpose. An upper bound upon that conservatism is found and two alternative methods are proposed. The second topic concerns ILRT retesting requirements. Failure of two consecutive As Found tests places a unit on an accelerated schedule. Using data from previous contain-

ment leak tests, it will be discussed whether As Found ILRT failures are more often the results of leakage from locally tested valves, hatches, and penetrations or from the containment structure and other areas that can be found only from Type A testing. The approximate average cost of an ILRT both in terms of dollars and Man-Rem will be found. From this data, the affect upon containment integrity and cost to the utilities of accelerated Type A testing is discussed. The alternative concept of corrective action plans that address the specific sources of leakage are evaluated. Both topics discussed here are based upon the need to correct measured Type A test results with local leak test results. The NRC currently interprets 10CFR50 Appendix J to require such corrections when repairs or adjustments are performed in the inspection period prior to the Type A test. Commonwealth Edison Co. performs the corrections because stipulations in exemption requests submitted in 1974, (and since approved) made them mandatory.

22570 (NUREG/CP—0076, pp 153-166) **Preservice and inservice requirements for containment structures - a status report.** Sammataro, R.F. (General Dynamics Corp., Groton, CT). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Preservice and inservice requirements for Class MC containment structures are contained in Subsection IWE, Requirements for Class MC Components of Light-Water Cooled Power Plants, of Section XI. Rules for Inservice Inspection of Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code. Rules for the preservice examination, inservice inspection, repair, modification, replacement and system pressure tests for Class MC (metal) containments and steel portions of Class CC (concrete) containments not backed up by concrete and their integral attachments in PWR and BWR light-water cooled nuclear power plants are included. Rules for Class CC containments are currently being developed and will be published in Subsection IWL, Requirements for Class CC Components of Light-Water Cooled Power Plants. First published in the Winter, 1981 Addenda to Section XI, Subsection IWE has been adopted by a number of state jurisdictions and is presently being reviewed by the Nuclear Regulatory Commission for adoption in Title 10. Part 50 of the Code of Federal Regulations (10CFR50). In the interim, ASME Nuclear Code Case N-236, Repair and Replacement of Class MC Vessels, may be used for the preservice examination, repair welding, acceptance standards, system pressure tests, and replacements for metal containment structures. When approved, the requirements in Subsection IWE and Subsection IWL will provide a reasonable and systematic basis for assuring the integrity of a containment vessel during its service lifetime and will require mandatory compliance by plant owners. This paper provides an overview of these requirements with emphasis on the practical considerations that should accompany user compliance.

22571 (NUREG/CP—0076, pp 167-172) **Review of containment examination and testing requirements.** Cook, J.F. (EG & G Idaho, Inc., Idaho Falls). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

At the present time, the ASME Code Section XI, Division 1, Subsection IWE, requirements for metal containment inservice inspection are not specifically referenced in the Nuclear Regulatory Commission (NRC) Regulations. A review of Subsection IWE is being performed by the Idaho National Engineering Laboratory (INEL) to assist the NRC in evaluating the acceptability of incorporating this Subsection into the NRC Regulations. The impact of Subsection IWE requirement changes compared with the present containment inservice inspection (ISI) requirements contained in Appendix J of the NRC Regulations is discussed. In addition, INEL recommendations for improvements/changes in containment ISI requirements are presented for consideration by personnel of code/standards committees and the NRC staff. For example, quantification of requirements for leak testing of localized areas in pressure boundaries is needed. Paragraph IWE-1221 (b) calls out testing for leak tightness using a gas medium test such as a Halide Detector test. The sensitivity required and acceptance criteria for this test should be specified. Both a bubble solution test and a helium mass spectrometer test are gas medium tests, but their sensitivities could vary by a factor of 10^6. Development of training programs and qualification requirements for personnel who conduct the Appendix J containment leakage tests are also recommended.

22572 (NUREG/CP—0076, pp 173-184) **Pending revisions to ANS 56.8-81 containment systems leakage testing requirements.** Brown, T.M. (Wiss, Janney, Elstner Associates, Inc.). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The US Nuclear Regulatory Commission is currently processing a revision to Appendix J of Part 50, Title 10 of the Code of Federal Regulations. The revised Appendix J will not reference any ANSI standard. Processed concurrently with the revised Appendix J is a draft Regulatory Guide which does endorse ANS Standard 56.8. The draft Regulatory Guide currently takes many exceptions to the Standard. Many of the exceptions are changes the Working Group had in process and the exceptions are to bring the draft Regulatory Guide in line with the future Standard. The Working Group has completed their revisions to the Standard and its appendices. These revisions have been submitted to the Nuclear Power Plants Standards Committee (NUPPSCO). The NUPPSCO comments have recently been addressed by the Working Group and the Working Group response has been sent to the NUPPSCO commentators. This paper will discuss the revisions made to the Standard, the significance of the revisions and future tasks or Standard revisions which the ANS 56.8 Working Group may address.

22573 (NUREG/CP—0076, pp 185-204) **Methods for determining integrated leakage rate test duration - case studies.** Young, L.R. (Bechtel Power Corp.). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Data from sixteen Integrated Leakage Rate Tests (ILRT) are examined to determine which of the evaluated methods provides the shortest duration and reliable test results. The methods of analysis examined are: Mass Point Method; Total time Method; Parabolic Inequality Method; Hybrid Method; and Predictor Method. The methods are examined to determine the shortest duration at which all acceptance criteria are satisfied. A method to determine ILRT duration is recommended.

22574 (NUREG/CP—0076, pp 205-220) **Alternative containment integrity test methods, an overview of possible techniques.** Spletzer, B.L. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

A study is being conducted to develop and analyze alternative methods for testing of containment integrity. The study is focused on techniques for continuously monitoring containment integrity to provide rapid detection of existing leaks, thus providing greater certainty of the integrity of the containment at any time. The study is also intended to develop techniques applicable to the currently required Type A integrated leakage rate tests. A brief discussion of the range of alternative methods currently being considered is presented. The methods include applicability to all major containment types, operating and shutdown plant conditions, and quantitative and qualitative leakage measurements. The techniques are analyzed in accordance with the current state of knowledge of each method. The bulk of the techniques discussed are in the conceptual stage, have not been tested in actual plant conditions, and are presented here as a possible future direction for evaluating containment integrity. Of the methods considered, no single method provides optimum performance for all containment types. Several methods are limited in the types of containment for which they are applicable. The results of the study to date indicate that techniques for continuous monitoring of containment integrity exist for many plants and may be implemented at modest cost.

22575 (NUREG/CP—0076, pp 223-236) **Integrated analysis of core debris interactions and their effects on containment integrity using the CONTAIN computer code.** Carroll, D.E.; Tills, J.L.; Valdez, G.D.; Bergeron, K.D.; Williams, D.C. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The CONTAIN computer code includes a versatile system of phenomenological models for analyzing the physical, chemical and radiological conditions inside the containment building during severe reactor accidents. Important contributors to these conditions are the interactions which may occur between released corium and cavity concrete. The phenomena associated with interactions between ejected corium debris and the containment atmosphere (Direct Containment Heating or DCH) also pose a potential threat to containment integrity. In this paper, they describe recent enhancements of the CONTAIN code which allow an integrated analysis of these effects in the presence of other mitigating or aggravating physical processes. In particular, the recent inclusion of the CORCON and VANESA models is described and a calculational example presented. With this capability CONTAIN can model core-concrete interactions occurring simultaneously in multiple compartments and can couple the aerosols thereby generated to the mechanistic description of all atmospheric aerosol components. Also discussed are some recent results of modeling the phenomena involved in Direct Containment Heating.

22576 (NUREG/CP—0076, pp 237-250) **Hydrogen deflagration tests in hydro-sc facility.** Carcassi, M.; Fineschi, F.; Lombardi, G. (Universita di Pisa, Italy). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

In severe accidents, large amounts of hydrogen may be released in the safety containment of a nuclear plant and the gas mixture may become explosive. The University of Pisa and ENEA have undertaken an experimental program to study the physics of the flame propagation in a containment model in accidental conditions. Up to now 41 deflagration tests have been performed with HYDRO-SC facility at ambient pressure and temperature. Concentrations, water spray conditions, ignition source and gas turbulence level were varied. The vessel volume was 0.5 m^3, the ignition sources were an electrical spark discharge and an electrically heated surface (glow-plug), the hydrogen molar fractions were in the range 4-16%, the turbulence was generated by fan or spray and two different spray nozzles were utilized. The experimental data indicate that the peak pressures nearly fit the adiabatic isochoric values at the highest hydrogen concentrations and gas turbulences. Weak pressure waves were observed for H_2 molar fractions greater than 10%. a Careful examination of the pressure and temperature transients gave information on the flame path and on the heat transfer process during and after the combustion. The glow plus igniter has proved to be a reliable tool for use in deliberate ignition schemes for hydrogen control in nuclear plants.

22577 (NUREG/CP—0076, pp 251-266) **Scaling and extrapolation of hydrogen distribution experiments.** Karwat, H. (Technological Univ., Munich, West Germany). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The containment plays an important role in predicting the residual risk to the environment under severe accident conditions. Risk analyses show that massive fission product release from the reactor fuel can occur only if during a loss of coolant the core is severely damaged and a containment failure is anticipated. Large amounts of hydrogen inevitably, are formed during the core degradation and will be released into the containment. More combustible gases are produced later when the coremelt will contact the containment concrete. Thus a potential for an early containment failure exists if a massive hydrogen deflagration cannot be excluded. A more remote cause for early containment failure may be an energetic steam explosion which requires a number of independent conditions when the molten core material contacts residual coolant water. The prediction of the containment loads caused by a hydrogen combustion is dependent on the prediction of the combustion mode. In the paper an attempt is made to identify on basis of a dimensional analysis such areas for which particular care must be exercised when scale experimental evidence is interpreted and extrapolated with the aid of a computer code or a system of computer codes. The study is restricted to fluid dynamic phenomena of the gas distribution process within the containment atmosphere. The gas sources and the mechanical response of containment structures are considered as given boundary conditions under which the containment is to be analyzed.

22578 (NUREG/CP—0076, pp 267-285) **Two aspects of hydrogen risk.** Forestier, A.; Goldstein, S. (Commissariat a l'Energie Atomique, Saclay, France). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The hydrogen risk in nuclear reactors is an extensive problem which includes several aspects i.e.: the prediction of the total amount of hydrogen release, its mixing with air and possibility of overconcentration in parts of the containment, burning via deflagrations or detonations, mitigation, containment integrity etc. An extensive amount of work has already been devoted to this problem. The scope of this paper is to present two subjects related to hydrogen risk in PWR containments which are in progress at CEA.DEMT and which to the authors knowledge have been unsufficiently investigated up to now. The first is the possibility of stratification of hydrogen in a large volume when injected from the bottom. The related experimental work is described in section II. The second is the computation of detonation shock waves in confined or semi-confined volumes (section III) and the resulting impulsive load on the containments.

22579 (NUREG/CP—0076, pp 285-300) **Impact of a hydrogen ignition system on degraded core accident in a Mark III containment.** Centanaro, C. (Ansaldo S.P.A., Genova, Italy). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

One concern during the Three Mile Island (TMI) accident arose from the generation of a large amount of hydrogen within the reactor vessel and its migration to the containment building. Though at TMI the hydrogen burning didn't jeopardize the containment safety there is a concern that other weaker containment might be vulnerable either to hydrogen combustion or to more severe accident scenarios. Ansaldo Div. Impianti is very interested in the impact of hydrogen burning phenomena on BWR/6 plants with Mark III, free-standing steel containment. To improve the plant capability to withstand the threat of hydrogen burning inside the containment, the need of a new tool to dispose the hydrogen release was assessed and, as an ignition system (Sistema Bruciamento Idorgeno or SBI) was selected, Ansaldo Div. Impianti performed a feasibility study to evaluate its requirements and performances. As a support for this activity, some accident scenarios have been analyzed by means of a copy of HECTR code supplied on purpose by Sandia Labs.

22580 (NUREG/CP—0076, pp 301-316) **Hydrogen burn assessment with the CONTAIN code.** van Rij, H.M. (Netherlands Energy Research Foundation). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The CONTAIN computer code was developed at Sandia National Laboratories, under contract to the US Nuclear Regulatory Commission (NRC). The code is intended for calculations of containment loads during severe accidents and for prediction of the radioactive source term in the event that the containment leaks or fails. A strong point of the CONTAIN code is the continuous interaction of the thermal-hydraulics phenomena, aerosol behavior and

fission product behavior. The CONTAIN code can be used for Light Water Reactors as well as Liquid Metal Reactors. In order to evaluate the CONTAIN code on its merits, comparisons between the code and experiments must be made. In this paper, CONTAIN calculations for the hydrogen burn experiments, carried out at the Nevada Test Site (NTS), are presented and compared with the experimental data. In the Large-Scale Hydrogen Combustion Facility at the NTS, 21 tests have been carried out. These tests were sponsored by the NRC and the Electric Power Research Institute (EPRI). The tests, carried out by EG & G, were performed in a spherical vessel 16 m in diameter with a design pressure of 700 kPa, substantially higher than that of most commercial nuclear containment buildings.

22581 (NUREG/CP—0076, pp 317-332) **Containment response and radiological release for a TMLB accident sequence in a large dry containment.** Gasser, R.D.; Bieniarz, P.P.; Tills, J.L. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

An analysis has been performed for the Bellefonte Pressurized Water Reactor (PWR) Unit 1 to determine the containment loading and the radiological releases into the environment from a station blackout accident. A number of issues have been addressed in this analysis, which include the effects of direct heating on containment loading and the effects of fission product heating and natural convection on releases from the primary system. The results indicate that direct heating which involves more than about 50% of the core can fail the Bellefonte containment, but natural convection in the Reactor Coolant System (RCS) may lead to overheating and failure of the primary system piping before core slump, thus, eliminating or mitigating direct heating. Releases from the primary system are significantly increased before vessel breach due to natural circulation and after vessel breach due to reevolution of retained fission products by fission product heating of RCS structures.

22582 (NUREG/CP—0076, pp 335-350) **Plastic analysis of concrete containment structure.** Hindy, A.; Danay, A. (Ontario Hydro, Toronto). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Overpressure capacity of a box type concrete containment structure is evaluated. Plastic analysis of the finite element model is performed using a quadrilateral plate element of homogeneous material. A special approach is used to represent nonlinear properties of reinforced concrete, such as concrete cracking and crushing and steel yielding. Those properties are represented by a set of idealized stress-strain curves of equivalent homogeneous sections. The analysis allows for a better estimate of the overpressure capacity of the containment structure while keeping the computer cost low by avoiding the use of the more expensive reinforced concrete brick element.

22583 (NUREG/CP—0076, pp 351-366) **Simplified model for concrete at low confining pressures.** Hibbitt, H.D. (Hibbitt, Karlsson & Sorensen, Inc., Providence, RI). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The paper describes a model for the response of concrete at low confining pressures. The model uses a damaged elasticity and a crack detection surface in stress space to describe cracking, and a yield/flow surface to define the concrete's response in compressive states of stress. The model is simple enough that associated numerical algorithms can be implemented to allow the model to operate effectively in the context of an implicit finite element code: some modeling accuracy has been sacrificed for this purpose. Nevertheless, preliminary studies with the model indicate that it can give useful predictions.

22584 (NUREG/CP—0076, pp 367-376) **Effect of high temperature on integrity of concrete containment structures.** Bhat, P.D. (Ontario Hydro, Toronto). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The effect of high temperature on concrete material properties and structural behavior are studied in order to relate these effects to the performance of concrete containment structures. Salient data obtained from a test program undertaken to study the behavior of a restrained concrete structure under thermal gradient loads up to its ultimate limit are described. The preliminary results indicate that concrete material properties can be considered to remain unaltered up to temperatures of 100°C. The presence of thermal gradients did not significantly affect the structures ultimate mechanical load capacity. Relaxation of restraint forces due to creep was found to be an important factor. The test findings are compared with the observations made in available literature. The effect of test findings on the integrity analysis of a containment structure are discussed. The problem is studied from the viewpoint of a CANDU heavy water reactor containment.

22585 (NUREG/CP—0076, pp 377-390) **Results of large-scale test of discontinuity region in a prestressed concrete containment.** Hanson, N.W.; Schultz, D.M.; Roller, J.J. (Portland Cement Association, Skokie, IL). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The test described in this paper is part of an Electric Power Research Institute (EPRI) program (Research Program RP2172-2) to provide a test-verified analytical method of estimating capacities of concrete reactor containment buildings under internal overpressurization from postulated degraded core accidents. Phase 2 of the EPRI program, on which this paper is based, includes tests of five large-scale specimens with steel liner plates. The specimens represent structural element of prestressed concrete containment buildings. Four full-scale square wall element specimens and one specimen representing the wall/basemat junction region were tested. This paper describes results of the wall/basemat junction region test. Results of this experimental work indicate that highly localized strains in the steel liner plate caused by internal overpressurization or other accident conditions can result in liner tearing and subsequent containment leakage. It appears that this liner tearing occurs in a controlled manner. Extrapolating from these test results, leakage and depressurization is more likely to occur than global failure.

22586 (NUREG/CP—0076, pp 391-406) **Analytical correlation and interpretation of full scale containment specimen tests.** Dameron, R.A.; Dunham, R.S.; Rashid, Y.R.; Tang, H.T. (ANATECH International Corp., La Jolla, CA). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The work presented in this paper is part of an EPRI-sponsored research program to develop experimentally verified methodology for predicting failure modes and leakage characteristics of concrete containments. This paper deals specifically with recent results of the analytical correlation and interpretation of full scale specimen tests. Computational models of specimens are described, and pre-test and post-test analysis results are presented. The importance of local effects is discussed, and the role of specimen tests and analyses in failure prediction of containment structures is summarized.

22587 (NUREG/CP—0076, pp 407-428) **Construction and analysis of a 1/6th-scale concrete containment model.** Horschel, D.S.; Jung, J. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper discusses the features and preliminary analysis of a 1/6th-scale reinforced concrete containment model, which is being constructed at Sandia National Laboratories (SNL) in Albuquerque, New Mexico. The model LWR containment building was designed and is being built to the ASME code by United Engineers and Constructors Inc. The containment model will be tested to failure to determine its behavior to static overpressurization. The results from testing the heavily instrumented containment will be used to assess the capability of analytical methods.

22588 (NUREG/CP—0076, pp 429-444) **Evaluation of structural failure modes for prestressed concrete containments.** Shunmugavel, P.; Gurbuz, O. (Bechtel Power Corp., Norwalk, CA). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Prestressed Concrete Containment Vessels (PCCV's) have been traditionally used as secondary containments for Pressurized Water Reactors (PWR's). A typical PCCV is shown in Figure 1. This paper presents analytically predicted ultimate pressures and seismic levels for PCCV's, considering various modes of failures. Results for six containments are presented, and correlated with the available test data. The analytical methods use either classical techniques or finite element analyses. The ultimate capacity calculations are based upon conservative deterministic estimates of strength of the structure, under both internal pressure and earthquake loads.

22589 (NUREG/CP—0076, pp 445-460) **Influence of non-linearity and foundation behavior on containment integrity.** Evans, J.J.B.; Keogh, P.M. (Ove Arup & Partners, London, England). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507-).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

A series of analyses have been carried out to examine the structural behavior of a PWR containment subjected to internal pressure. The containment examined was of the type proposed for Sizewell B in England. The analyses considered variations and non-linear behavior in the soil properties, the influence of the reactor pit and the effect of non-linear behavior of the prestressed concrete walls. The philosophy adopted throughout this work was to use simplified engineering methods to assess the significant aspects of the response of the containment and establish areas for particular attention in the design. The paper records the results obtained and identified the benefit of increasing shear strength at the wall base interface to a level that ensures it is not a dominant failure mechanism.

22590 (NUREG/CP—0076, pp 463-478) **Structural analysis of a Japanese BWR MARK-I containment under internal pressure loading.** Isozaki, T.; Soda, K.; Miyazono, S. (Japan Atomic Energy Research Institute, Tokai, Ibaraki). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper describes the elastic-plastic analysis of the Japanese BWR Mark-I steel containment vessel under pressure loadings by general purpose Finite Element Method code ADINA. The present study is focused on an entire deformation of the vessel rather than the stress or strain concentrations around the structural singularities such as penetrations. Elastic deformation limit, displacement, equivalent stress and strain distributions are discussed.

22591 (NUREG/CP—0076, pp 479-494) **Crack propagation in high strain regions of a steel containment.** Fanous, F.; Greimann, L. (Iowa State Univ., Ames). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

During a severe accident, a containment may develop a controlled relatively small leak before the pressure reaches the point where general rupture of the shell occurs. Another hypothesis states that an overall failure will occur with total release of the vessel contents. This work represents a preliminary study to predict crack propagation from an initially small defect in a high strain location in a typical steel containment. The J integral approach is used. A virtual crack extension method for calculating J is developed for use with general finite element programs. Two through cracks with different lengths were found to be unstable at the pressure which caused a surface crack to propagate through the containment thickness. In other words, the resulting through crack will not be stable and general failure will occur with the almost instantaneous release of the vessel contents.

22592 (NUREG/CP—0076, pp 495-510) **Failure mechanisms of LWR steel containment buildings subject to severe accident loadings.** Clauss, D.B. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The potential failure mechanisms in LWR steel containment buildings subject to quasi-static pressurization and elevated temperature are identified. For each failure mechanism, the relevant structural response measures are discussed. For mechanisms involving leakage, the importance of seal performance is also discussed. Criteria that can be used to evaluate threshold environments are presented for several failure mechanisms. Results of tests on scale models and seal tests that support the criteria are referenced.

22593 (NUREG/CP—0076, pp 511-526) **Failure pressure and failure mode of the latest type of German PWR containments.** Krieg, R.; Goeller, B.; Messemer, G.; Wolf, E. (Institut fuer Reaktorentwicklung, Karlsruhe, West Germany). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

For the pressurized water reactor Philippsburg (KKP II) a slowly increasing containment pressure typical for a core melt accident is assumed. The failure pressure and failure mode of the containment are determined. It turns out that the sealing box covering the bolted connection at the equipment hatch will fail at a containment overpressure between 12.9 and 13.7 bar. Then the leakage through the bolted connection is sufficient to prevent further pressure increase. However, if the sealing box failed at a somewhat higher pressure, a global containment failure with extreme mechanical damage would have to be expected.

22594 (NUREG/CP—0076, pp 527-548) **Analysis of severe accidents and estimates of ultimate loading capacity of the steel containment.** Heuser, F.W.; Hoefler, A.; Schulz, H. (Gesellschaft fuer Reaktorsicherheit, Koeln, West Germany). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

Referring to a German PWR (Biblis B) on overview on the analysis of severe accidents is given, performed within the German Risk Study, Phase B. The course of hypothetical core melt accidents, potential containment failure modes and sequences leading to radioactive release are discussed briefly. Then the ultimate loading capacity and the potential for limited leakage of the spherical steel containment of the reference plant are analyzed, based on pressure and temperature loading according to core melt accidents and H_2-deflagration. Most analyses have been performed by elastic-plastic FE-calculations including shell disturbances caused by nozzles and locks as well as constraints. By assessment of strains and stresses against different failure criteria scatter bands of the ultimate pressures could be investigated.

22595 (NUREG/CP—0076, pp 549-556) **Small scale model for experimental investigations of the dynamic behavior of spherical steel containments.** Wolf, E.; Goeller, B. (Institut fuer Reaktorentwicklung, Karlsruhe, West Germany). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

In order to study the influence of imperfections on the earthquake response of spherical steel containments corresponding theoretical and experimental investigations were started. The experimental investigations will be performed with a small scale model with a diameter of 1.3 m and a wall thickness of about 1 mm. The necessary high precision of the spherical model required a complicated manufacturing process. The steps of this process and the resulting tolerances of the model are discussed in this paper.

22596 (NUREG/CP—0076, pp 557-568) **Leakage potential through mechanical penetrations in a severe accident environment.** Koenig, L.N. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—). Contract AC04-76DP00789.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper reviews the findings of an ongoing program, Integrity of Containment Penetrations Under Severe Accident Loads. The program is concerned with the leakage modes as well as the magnitude of leakage through mechanical penetrations in a containment building subject to a severe accident. Seal and gasket tests are used to evaluate the effect of radiation aging, thermal aging, seal geometry, and seal squeeze on seals and gaskets subjected to a hypothesized severe accident. The effects on leakage of the structural response of equipment hatches, personnel airlocks, and drywell heads subjected to severe accident pressures are studied by experiments and analyses. The data gathered during this program will be used to develop methodologies for predicting leakage.

22597 (NUREG/CP—0076, pp 569-579) **Leak behavior through EPAs under severe accident conditions.** Keck, J.D.; Thome, F.V. (Sandia National Labs., Albuquerque, NM). Aug 1986. NTIS, PC A24/MF A01- GPO. File Number TI87001422. (SAND—86-0618; CONF-860507—).

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The leakage behavior of electrical penetration assemblies (EPAs) is being evaluated by varying the penetration type, manufacturer, and hypothetical temperature and pressure accident profile. Nuclear qualified EPAs were procured from D.G. O'Brien, Westinghouse, and Conax. Severe-accident-sequence-analysis was used to generate the severe-accident-conditions (SAC) for a large dry PWR, a BWR Mark I drywell, and a BWR Mark III wetwell. The EPA manufacturers were matched to the reactor type based on a survey of EPAs used in reactors. The D.G. O'Brien EPA was chosen for the PWR SAC, the Westinghouse was chosen for the BWR Mark III, and the Conax was chosen for the BWR Mark I. The EPAs were radiation and thermal aged to a 40 year service life before the SAC test was conducted. For the D.G. O'Brien EPA SAC test, while there was no detectable leakage during the SAC test, there was a 0.13 scc/sec leak measured during the post-test inspection. For a Westinghouse EPA SAC test, there was no detectable leakage during or after the SAC test. The Conax EPA SAC test is scheduled for completion in July, 1986.

22598 (NUREG/CR—4301) **Equipment qualification issues research and resolution: Status report.** Bonzon, L.L.; Wyant, F.J.; Bustard, L.D.; Gillen, K.T. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Nov 1986. Contract AC04-76DP00789. 580p. (SAND—85-1309). NTIS, PC A25/MF A01 - GPO. File Number TI87005451.

Since its inception in 1975, the Qualification Testing Evaluation (QTE) Program has produced numerous results pertinent to equipment qualification issues. Many have been incorporated into Regulatory Guides, Rules, and industry practices and standards. This report summarizes the numerous reports and findings to date. Thirty separate issues are discussed encompassing three generic areas: accident simulation methods, aging simulation methods, and special topics related to equipment qualification. Each issue-specific section contains (1) a brief description of the issue, (2) a summary of the applicable research effort, and (3) a summary of the findings to date.

22599 (NUREG/CR—4793) **Results of Semiscale Mod-2C small-break loss-of-coolant accident without HPI [high-pressure injection] (S-NH) experiment series.** Streit, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1987. Contract AC07-76ID01570. 57p. (EGG—2482). NTIS, PC A04/MF A01 - GPO. File Number TI87006118.

Four experiments simulating small-break, loss-of-coolant accidents of 0.5% and 2.1% without high-pressure injection were performed in the Semicale Mod-2C facility. These experiments differed in break size and recovery procedures. Three of the experiments had the same break size (0.5%), but recovery procedures were varied to determine what influence various procedures had on transient severity. The recovery procedures included secondary steam-and-feed initiation when a condition of inadequate core cooling was detected, secondary steam-and-feed initiation when the vessel level reached the top of the core (before a condition of inadequate are cooling was detected), and the restart of a primary coolant pump when a condition of inadequate core cooling was detected. The influence of the break size on the transient severity was also studied with the inclusion of the 2.1% break transient with secondary steam-and-feed initiation when a condition of inadequate core cooling was detected. All four of the experiments were performed at high pressure and temperature [15.6 MPa (2262 psia) primary system pressure; 37.5 K (67.5°F) core differential temperature; 587 K (597°F) hot leg fluid temperature] and all four experiments had an initial bypass flow rate near 3%. Comparisons are made between the four experiments and conclusions drawn regarding what recovery procedures to use to prevent heater rod temperature excursions.

22600 (NUREG/CR—4797) **Progress reviews of six safety parameter display systems.** Liner, R.T. Jr.; DeBor, J. (Science Applications International Corp., McLean, VA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of PWR Licensing-A). Mar 1987. 68p. (SAIC—86/3066). NTIS, PC A04/MF A01 - GPO. File Number TI87900554.

A pilot program of progress reviews of Safety Parameter Display Systems (SPDSs) was carried out through information-gathering visits to six plants in the period June to November 1985. The purpose was to sample industry progress toward the SPDS requirements stated in NUREG-0737 Supplement 1 and thereby to determine the need for a post-implementation audit program. While three plants had, to varying degrees, demonstrated the viability of the SPDS concept through effective implementation, three of the six plants, some having been declared operational for as long as two years, had encountered major problems to the extent that their SPDSs could confuse or mislead operators in an emergency. The problems observed had not been apparent from prior reviews of Safety Analysis Reports on the systems. Major conclusions were that (1) a significant number of plants may be having problems with their SPDSs, and (2) assurance that any given SPDS meets the requirements cannot be determined with reasonable confidence without an on-site audit and discussions with personnel responsible for developing, operating, and maintaining the system. This report summarizes observations from the six plant visits and presents a plan, with procedures and guidance, for conducting post-implementation audits of additional SPDSs if they are undertaken.

22601 (NUREG/CR—4861) **Development of site specific response spectra.** Bernreuter, D.L.; Chen, J.C.; Savy, J.B. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Mar 1987. Contract W-7405-ENG-48. 138p. (UCID—20980). NTIS, PC A07/MF A01 - GPO. File Number TI87007073.

For a number of years the US Nuclear Regulatory Commission (NRC) has employed site specific spectra (SSSP) in their evaluation of the adequacy of the Safe Shutdown Earthquake (SSE). These spectra were developed only from the spectra of the horizontal components of the ground motion and from a very limited data set. As the data set has considerably increased for Eastern North America (ENA) and as more relevant data has become available from earthquakes occurring in other parts of the world (e.g., Italy), together with the fact that recent data indicated the importance of the vertical component, it became clear that an update of

the SSSP's for ENA was desirable. The methodology used in this study is similar to the previous ones in that it used actual earthquake ground motion data with magnitudes within a certain range and recorded at distances and at sites similar to those that would be chosen for the definition of an SSE. An extensive analysis of the origin and size of the uncertainty is an important part of this study. The results of this analysis of the uncertainties is used to develop criteria for selecting the earthquake records to be used in the derivation of the SSSP's. We concluded that the SSSPs were not very sensitive to the distribution of the source to site distance of the earthquake records used in the analysis. That is, the variability (uncertainty) introduced by the range of distances was relatively small compared to the variability introduced by other factors. We also concluded that the SSSP are somewhat sensitive to the distribution of the magnitudes of these earthquakes, particularly at rock sites and, by inference, at shallow soil sites. We found that one important criterion in selecting records to generate SSSP is the depth of soil at the site.

22602 **(NUREG/IA—0004) Thermal mixing tests in a semiannular downcomer with interacting flows from cold legs: International Agreement Report.** Tuomisto, H.; Mustonen, P. (Imatran Voima Oy, Helsinki (Finland); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1986. 343p. NTIS, PC A15/MF A01 - GPO. File Number TI87900527.

This report describes the test facility and test program for studying thermal mixing of high-pressure injection (HPI) water in the two-fifths scale model of three cold legs, semiannular downcomer and lower plenum of a pressurized water reactor. This test series has been carried out by mutual agreement on the pressurized thermal shock (PTS) information exchange between the US Nuclear Regulation Commission and Imatran Voima Oy. The test facility was originally designed to model the Finnish Loviisa plant but it was redesigned and modified for this test program. The facility can be operated at atmospheric pressure with loop and HPI flows from different cold legs in the area of interest to PTS. Transparent materials were used to allow flow visualization during the tests. The choice of transparent materials limit the upper temperature to 75°C. The full buoyancy effect was induced by salt addition and the HPI temperature was used as a tracer. The test matrix consists of 20 tests. The varied parameters were flow rates and the number and configuration of cold legs with HPI and loop flows. Four tests were done with decreasing loop flow temperature to simulate primary flows during steam line breaks.

22603 **(RISO-M—2584) Reliability calculations. Improvements of methods intended for calculation of reliability of structures and systems.** Petersen, K.E. (Risoe National Lab., Roskilde (Denmark)). Mar 1986. 140p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750663.

Risk and reliability analysis is increasingly being used in evaluations of plant safety and plant reliability. The analysis can be performed either during the design process or during the operation time, with the purpose to improve the safety or the reliability. Due to plant complexity and safety and availability requirements, sophisticated tools, which are flexible and efficient, are needed. Such tools have been developed in the last 20 years and they have to be continuously refined to meet the growing requirements. Two different areas of application were analysed. In structural reliability probabilistic approaches have been introduced in some cases for the calculation of the reliability of structures or components. A new computer program has been developed based upon numerical integration in several variables. In systems reliability Monte Carlo simulation programs are used especially in analysis of very complex systems. In order to increase the applicability of the programs variance reduction techniques can be applied to speed up the calculation process. Variance reduction techniques have been studied and procedures for implementation of importance sampling are suggested.

22604 **(SIS—1986:9) Activities, projects and emergency planning etc., at the National Institute of Radiation Hygiene in connection with the Chernobyl reactor accident.** Berteig, L. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 37p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750893.

The National Institute of Radiation Hygiene (SIS) is the competent authority for radiation hygiene in Norway according to Act No. 1 of 18 June 1938 and regulations given pursuant to the act. Legislation on duties specific to radiological emergencies in general has not been issued in Norway. The report describes how SIS organized the fallout survey and summarizes the different projects implemented by the institute after the Chernobyl accident. Furthermore, the institutes view on an alert system for detection of radiactive contamination and on emergency planning for radiation accidents is expressed.

22605 **Considerations for realistic emergency core cooling system evaluation methodology for light water reactors.** Rohatgi, U.S.; Saha, P.; Chexal, V.K. (Brookhaven National Lab., Upton, NY 11973). *Nuclear Technology;* **76**: No. 1, 11-26(Jan 1987).

Various phenomena governing the course of large- and small-break loss-of-coolant accidents in light water reactors and affecting the key parameters such as peak cladding temperature, and timing of the end of blowdown, beginning of reflood, and complete quench have been identified. The models and the correlations for these phenomena in the current literature, in advance codes, and as prescribed in the current emergency core cooling system methodology as outlined in Appendix K of CFR50 have been reviewed. It was found that the models and correlations in the present best-estimate codes such as TRAC or RELAP5 could be made more realistic by incorporating some of these models from the literature. However, an assessment program will be needed for the finai selection of the models for the codes.

22606 **Determination of appendix K conservatisms for Westinghouse pressurized water reactors using TRAC-PD2/MOD1.** Rohatgi, U.S.; Yuelys-Miksis, C.; Saha, P. (Brookhaven National Lab., Upton, NY 11973). *Nuclear Technology;* **76**: No. 1, 41-50(Jan 1987).

A 200% cold-leg break accident in a Westinghouse four-loop RESAR-3S plant has been analyzed using the best-estimate code TRAC-PD2/MOD1/Version 27 with updates. Three TRAC calculations have been performed. The first calculation used the best-estimate or realistic initial and boundary conditions and scenarios and the other two calculations, one with and one without locked rotor resistance, used the licensing conditions. These calculations produced the peak cladding temperatures (PCTs) of 800.5, 1072, and 1153 K, respectively. Comparison of these results with the Westinghouse licensing calculations performed in accordance with the guidelines in Appendix K of 10CFR50 shows an overall safety margin of 663 K, of which 352.5 K is due to the conservative initial and boundary conditions and scenario. The remaining 310.5 K is due to conservative physical models. The locked rotor resistance contributed —81 K to PCT.

22607 **Passive emergency cooling systems for boiling water reactors (PECOS-BWR).** Forsberg, C.W. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). *Nuclear Technology;* **76**: No. 1, 185-192(Jan 1987).

Current boiling water reactors (BWRs) use active safety systems comprised of pumps, valves, motors, and diesel generators. These active safety systems (a) are a major cause of controversy in licensing power reactors because of reliability questions, (b) have high capital costs, and (c) require constant maintenance. An advanced BWR concept with passive emergency core cooling systems (PECOS) offers a basic alternative approach to reactor safety. In the PECOS-BWR, passive emergency core cooling is provided for the first 24 h by gravity flow of stored water released through fluidic valves that have no moving parts. Natural-draft air cooling removes heat from the core for longer periods.

22608 **Nuclear Computerized Library for Assessing Reactor Risk (NUCLARR).** Gilmore, W.E.; Blackman, H.S.; Ryan, T.G. (Idaho National Engineering Lab., Idaho Falls). *Transactions of the American Nuclear Society;* **53**: 142-143(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The Nuclear Computerized Library for Assessing Reactor Risk (NUCLARR) program is a multiyear effort sponsored by the NRC and is being conducted at the Idaho National Engineering Laboratory (INEL). The goal of this program is to establish and operate computerized data base management tools for the human reliability data bank specification developed by Comer and Donovan. The NRC and the risk analysis community recognized that implementing a fully functional library would not be feasible, or practical, without the aid of computerized tools for management and manipulation of its data sources. The end users of the NUCLARR can be classified into three categories according to specific needs. The first category is those users interested in reviewing individual data sources for a given situation. The second category of users selects multiple data sources for a specific case, summarizing the information, and performing comparative studies. The last category of users interfaces the NUCLARR with other programming applications, such as other data banks, and simulation models of risk assessment. Project status is provided in the paper.

22609 **Assessment and improvement of spectrum-broadening procedure in piping design.** Lu, S.C.; Tsai, N.C. (Lawrence Livermore National Lab., Livermore, CA). pp 43-50 of Seismic engineering for piping systems, tanks and power plant equipment. Liu, T.H.; Chen, P.Y.; Patel, Y.A.; Ma, D.C. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

A literature review was conducted to assess the uncertainty in both the structure and piping frequencies that is necessary for the seismic design of nuclear piping systems. The assessment suggests that an uncertainty range of +- 30% is appropriate for both the structure and piping frequencies. A technical approach is then formulated for developing an improved spectrum broadening procedure that will be practical for implementation and will adequately account for the recommended uncertainty in structure and piping frequencies.

22610 **The effect of PVRC damping with independent support motion response spectrum analysis of piping systems.** Wang, Y.K.; Bezler, P.; Shteyngart, S. (Structural Analysis Div., Dept. of Nuclear Energy, Brookhaven National Lab., Upton, NY). pp 1-12 of Seismic engineering for piping systems, tanks and power plant equipment. Liu, T.H.; Chen, P.Y.; Patel, Y.A.; Ma, D.C. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

The Technical Committee for Piping Systems of the Pressure Vessel Research Committee (PVRC) has recommended new damping values to be used in the seismic analyses of piping systems in nuclear power plants. To evaluate the effect of coupling these recommendations with the use of independent support motion analyses methods, two sets of seismic analyses have been carried out for several piping systems. For each analysis set, the response spectrum results were compared with time history estimates of those results. Comparison tables were then prepared depicting the percentage by which the response spectrum estimates exceeded the time history estimates. By comparing the result tables between both analysis sets, the impact of PVRC damping can be observed. Preliminary results show that the degree of exceedance of the response spectrum estimates based on PVRC damping is less than that based on uniform damping for the same piping problem. Expressed differently the results obtained if ISM methods are coupled with PVRC damping are not as conservative as those obtained using uniform damping.

22611 **Mathematical and numerical models to achieve high speed with special-purpose parallel processors.** Cheng, H.S.; Wulff, W.; Mallen, A.N. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* 53: 271-272(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Historically, safety analyses and plant dynamic simulations have been and still are being carried out be means of detailed FORTRAN codes on expensive mainframe computers in time-consuming batch processing mode. These codes have grown to be so expensive to execute that their utilization depends increasingly on the availability of very expensive supercomputers. Thus, advanced technology for high-speed, low-cost, and accurate plant dynamic simulations is very much needed. Ideally, a low-cost facility based on a modern minicomputer can be dedicated to the staff of a power plant, which is easy and convenient to use, and which can simulate realistically plant transients at faster than real-time speeds. Such a simulation capability can enhance safety and plant utilization. One such simulation facility that has been developed is the Brookhaven National Laboratory (BNL) Plant Analyzer, currently set up for boiling water reactor plant simulations at up to seven times faster than real-time process speeds. The principal hardware components of the BNL Plant Analyzer are two units of special-purpose parallel processors, the AD10 of Applied Dynamics International and a PDP-11/34 host computer.

22612 **Evaluation of the vent header crack at Edwin I. Hatch Unit #2 Nuclear Power Station.** Czajkowski, C.J. (Brookhaven National Lab., Upton, NY). pp 151-158 of Analyzing failures: The problems and the solutions. Goel, V.S. Metals Park, OH; American Society for Metals (1985). (CONF-851203—).

From International conference and exhibition on fatigue, corrosion cracking, fracture mechanic and failure analysis; Salt Lake City, UT, USA (2 Dec 1985).

A metallurgical failure analysis was performed on pieces of the cracked vent header pipe from the Edwin I. Hatch Unit 2 Nuclear Power Plant. The analysis consisted of optical microscopy, chemical analysis, mechanical charpy impact testing and fractography. The general conclusions drawn from this analysis were: 1) the material of the vent header met the mechanical and chemical properties of ASTM A516 Gr. 70 material and that the microstructures were consistent with this material; 2) the fracture faces of the cracked pipe were predominantly brittle in appearance with no evidence of fatigue contribution; 3) the NDTT (Nil Ductility Transition Temperature) for this material is approximately -60°F (-51°C); and 4) the fact that the material's NDTT is significantly out of the normal operating range of the pipe suggests that an impingement of low temperature nitrogen (caused by a faulty torus inerting system) induced a thermal shock in the pipe which, when cooled below its NDTT, cracked in a brittle manner.

22613 **Guidebook to light water reactor systems safety analysis.** Abramson, P.B. New York, NY; Hemisphere Publishing (1985). 393p. Hemisphere Publishing, 79 Madison Avenue, New York, NY 10016.

This text provides reconsideration of all safety-related design, analysis, emergency procedures, and operator training of nuclear reactors. Recent accidents necessitate a reappraisal of nuclear plant safety. Research work and experience obtained through the analysis of reactor behavior under different conditions has enabled higher confidence in establishing new criteria for the assessment of reactor safety. The theoretical and technical aspects of developments in reactor safety assessment are treated.

25 ENERGY STORAGE

2506 Thermal

22614 **(AD-A—175955/4/XAB) Environmental control packages using below ambient-temperature thermal storage. Final report, 19 August 1985-28 February 1986 on Phase 1.** Keddy, M.D. (Thermacore, Inc., Lancaster, PA (USA)). 31 Mar 1986. 93p. NTIS, PC A05/MF A01.

Military vehicles are required to operate in high-temperature and high-humidity environments. Heat stress becomes a serious problem for the crew members aboard these vehicles. Thermal Energy Storage (TES) units, particularly those employing a phase-change material (PCM) can be used for cooling crew members operating in oppressive environments. This program assessed the role of heat pipes in overcoming the heat transfer problems inherent to PCM-type TES units. In so doing, a family of TES units that use heat-pipe heat exchangers were designed. The main conclusions

drawn from Phase I efforts are that: (1) heat pipes can be used to overcome the interface problems associated with TES-unit designs; and (2) TES units employing heat-pipe heat exchangers are capable of providing sufficient cooling for crew members aboard military vehicles operating in oppressive environments.

2509 Batteries

22615 (ANL—86-40, pp A.2) **Prediction of thermodynamic properties of molten salt solutions.** Saboungi, M.; Blander, M. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Theoretical advances in the past decade permit one to make a priori calculations of thermodynamic properties of a variety of ionic solutions and to greatly minimize the number of measurements necessary to define the chemical properties of technologically important electrolytes. In this review, some examples of value for high-temperature molten salt batteries and fuel cells are discussed.

22616 (ANL—86-40, pp A.3-A.16) **Spectral methods in the characterization of molten salts.** Newman, D.S. (Bowling Green State Univ., OH). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Special problems associated with spectroscopy of the liquid state in general, and ionic liquids in particular, are described. The concepts of the radial distribution function and the partition function are introduced and their relationship to liquid structure is discussed. Diffraction spectroscopy, optical spectroscopy, and nuclear magnetic resonance spectroscopy are discussed together with the kinds of structural information available from these experimental techniques. Correlations between optical spectra and structure and between NMR spectra and structure of molten salts are emphasized and described in some detail.

22617 (ANL—86-40, pp A.17-A.21) **Overview of transport mechanisms in β-lithium/aluminum.** Susman, S.; Brun, T.O.; Volin, K.J. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

A systematic study over a period of years has resulted in identifying (a) constitutional defects in β-LiAl at room temperature and (b) defects created at elevated temperatures. The relationship between these defects and charge and mass transport will be discussed. The results bear upon the use of LiAl as the negative electrode both in room-temperature and solid state batteries and in high-temperature, molten-salt electrochemical cells. The key to unravelling the Li-conduction mechanism has been the recognition that there is a critical composition within the β-phase domain corresponding to 50.7 atom% lithium. Free Li vacancies, bound Li vacancies, and reciprocal antisite defects contribute to the transport processes depending on temperature and composition. An understanding of these microscopic mechanisms has been used to remedy the loss of capacity with cycling of high temperature electrochemical cells.

22618 (ANL—86-40, pp A.22-A.31) **New negative electrode materials for molten salt batteries.** Huggins, R.A. (Stanford Univ., CA). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The cyclic behavior of electrochemical cells is often limited by negative electrode problems. These may include loss of capacity, increased impedance (which is observed as increased overvoltage), macroscopic shape change, dendrite growth, and a tendency for filamentary or whisker growth. In some cases these problems can be reduced or eliminated by the use of alloys that undergo either displacement or insertion reactions at activities less than unity, instead of the pure elements, as electrode reactants. While providing enhanced cycling behavior, this approach involves some sacrifice of both cell voltage and specific energy. The fundamental reasons for some of these problems with elemental electrodes are briefly discussed, and the basic background underlying the different behavior of alloys presented. The all-solid mixed-conductor matrix concept is reviewed briefly. In this approach, the thermodynamic behavior of two different binary alloy systems can be combined to produce dense all-solid electrodes that have the kinetic properties of fine particle dispersions, as well as potentially attractive microstructural reversibility upon cycling.

22619 (ANL—86-40, pp B.2-B.17) **Review of cell development for molten-salt battery.** Vissers, D.R. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

In the early 1970s, transition metal sulfides (FeS, FeS_2 and Cu_2S) and Li alloys (Li-Al and Li-Si) were identified as attractive positive and negative electrode materials, respectively, for molten-salt battery cells. The development effort that followed in the 1970s and 1980 resulted in fabrication of a Li-alloy/FeS cell with high performance (> 100 Wh/kg, 150 W/kg) and long cycle life (> 1000 cycles). Recent studies conducted with upper-plateau Li-Al/FeS_2 cells indicate performance superior to that reported for Li-alloy/FeS cells. The engineering development of the Li-alloy/FeS/sub x/ cells and the cell chemistry research which assisted that development are reviewed.

22620 (ANL—86-40, pp B.18-B.43) **Electrochemical methods in the analysis of high-temperature battery processes.** Selman, J.R. (Illinois Institute of Technology, Chicago). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The charge and discharge processes taking place in high-temperature batteries such as the lithium alloy/metal sulfide and sodium/sulfur batteries are characterized by the coexistence of solid and liquid phases, which may transform into each other via very complex reactions. Whereas the electrode-kinetic and mass transfer rates are usually rapid in molten salts, the phase transformation kinetics are often slow. These conditions require modification of the traditional techniques for studying electrode processes. In addition, the help of mathematical modeling is required if one wants to interpret the results of basic techniques such as potential step and potential sweep, or chronopotentiometry, quantitatively.

22621 (ANL—86-40, pp B.44-B.52) **Modeling of porous electrodes in molten-salt systems.** Newman, J. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Porous electrodes are used for many batteries because they permit the reactants to be close to the site of the electrochemical reaction. The basic for a nonuniform reaction distribution in such electrodes is reviewed, and some results are discussed for lithium alloy, iron sulfide cells. Discrepancies between model and experimental results can be attributed to poor approximations to the effective conductivity of packed-bed electrodes and to inadequate treatment of the precipitation of KCl.

22622 (ANL—86-40, pp B.53) **Development of a high performance lithium-alloy/metal sulfide cell for electric vehicle propulsion.** Barlow, G. (Gould Inc., Rolling Meadows, IL). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Lithium-alloy/metal sulfide molten salt rechargeable batteries have been under development for electric vehicle propulsion for about ten years. During this time a practical multi-plate monopolar cell design has been developed based on the lithium-alloy/iron monosulfide electrochemical couple. The state-of-the-art cell is a seven plate, negative electrode limited design with a theoretical capacity of 300 Ah (based on lithium) and a negative:positive capacity

ratio of 0.95. Cells of this type have specific energies of approximately 105 Wh/kg and 235 Wh/l at a C/3 discharge rate, a (15 sec.) peak power of approximately 130 W/kg at 80% depth of discharge and a cycle life of about 200 cycles. Cells of the design discussed recently have been incorporated into 9-cell battery modules and tested extensively at NBTL in Argonne National Laboratory.

22623 (ANL—86-40, pp B.54-B.58) **Design and test of lithium-alloy/iron monosulfide batteries.** Chilenskas, A.A.; Biwer, R.L.; DeLuca, W.H. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

A program has been initiated by the Electric Power Research Institute to examine the feasibility of using the Li-alloy/FeS battery for electric-vehicle propulsion. In the first phase of the program, a joint effort between Argonne National Laboratory and Gould Research Center resulted in the design, fabrication, and testing of two full-scale 12-V modules and related battery components at Argonne's National Battery Test Laboratory. The design of the module and battery components was based upon a van battery design study supported by the US Department of Energy. The objective of the Phase I program was to provide test data to the battery developers applicable to cell and module development, insulated case design, heating/cooling subsystem design, and charger development.

22624 (ANL—86-40, pp B.59-B.66) **Failure analysis of lithium-aluminum/iron sulfide cells.** Battles, J.E. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Post-test examinations were an integral part of the Li-alloy/FeS battery development program at Argonne National Laboratory. Important functions of post-test examinations were to determine the causes of cell failure and to provide recommendations on cell design and assembly techniques that would eliminate these failure modes. Cell failure was generally indicated by a sharp decline in the coulombic efficiency, which is the manifestation of an electrical short circuit between the positive and negative electrodes. Combinations of macroscopic and microscopic examinations were utilized to identify the source and cause of the short circuits. A special metallographic glovebox facility with a helium atmosphere was constructed for these examinations. Cell failure analysis was conducted on bicells (< 100-Ah capacity) from the early cell development program and on multiplate cells (about 200- and 400-Ah capacity) from the Mark IA and Mark II battery development programs. The results of the cell failure analysis for the bicell (~ 163 cells) and for the Mark IA multiplate cells were discussed in detail in a previous report, and are briefly summarized here.

22625 (ANL—86-40, pp B.67-B.71) **Molten salt research and development in Japan.** Ito, Y.; Shimotake, H. (Kyoto Univ., Japan). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

There is growing interest in the molten salt technology in Japan. New processes are being developed to produce a semiconductor material aluminum and other materials. The government is pursuing the development of molten carbonate fuel cells systems. The recent status and activities of these efforts in Japan are described.

22626 (ANL—86-40, pp B.72-B.87) **Materials selection for molten salt battery components.** Smaga, J.A. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Candidate materials for the hardware used in Li-alloy/FeS/sub x/ (x = 1,2) cells are reviewed. Intermetallic layer formation on negative electrode components is discussed, and methods to alleviate this deleterious reaction are examined. For the FeS electrode, the relative merits of current collectors made with low-carbon steel or nickel are compared. The FeS_2 electrode imposes the most stringent requirements for current collectors, but the development of ceramic-coated substrates may overcome some of the limitations of currently used materials, such as molybdenum. Both BN-felt and MgO-powder separators have demonstrated successful performance in operating cells, but advances in the fabrication of ceramic structures have not been fully applied to separator development. Similarly, alternative feedthrough designs may offer improvements over the compression-type feedthroughs that are currently used.

22627 (ANL—86-40, pp B.88-B.91) **Status of LiAl/FeS cells based on BN separators.** Gupta, S.D.; Ghosh, D.; Jacobs, J.K.; Machler, M. (Electrofuel Manufacturing Co., Toronto, Ontario). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

For the last three years an engineering development program has been carried out on the LiAl/FeS cells. At the start of the development program it was decided that a low cost process was necessary for producing good quality Boron Nitride fibers. A research and development program was launched and good quality BN fibers and felts are now commercially available from Electrofuel. The BN fibers are about 4 microns in diameter and are available as tows or felts. The engineering development program for the LiAl/FeS cells has concentrated in attempting to make reliable cells which can be manufactured through standard production practices. Hence attempts have been made to use non exotic materials, duplicate large scale production methodology and give low priority to cell performance. It was felt that the performance potential of the technology was well established and needed no further demonstration. As a result of this development work it appears that the manufacture of the LiAl/FeS cells can be both technically feasible and cost effective. Presently a battery development program has been initiated.

22628 (ANL—86-40, pp B.92-B.100) **Reference-electrode systems and their application in Li/MS/sub x/ battery research.** Redey, L. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Three reference electrode systems, Li-Al/Li^+, Ni/Ni_3S_2/S^{2-}, and Ag/Ag^+, are described briefly and evaluated on the basis of experience gained during about 200,000 test hours. The Li-Al/Li^+ system has been selected as the primary standard because of the convenience of in situ calibration and the availability of a technique that unmistakably manifests the standard condition of the electrode. The Ni/Ni_3S_2 reference electrode is extremely stable, with slow potential shift of no more than +/- 2-3 mV during thousands of hours of operation. The short-range stability (less than 100 hours) is +/- 0.1 mV. Advantages of the Ag/Ag^+ membrane electrode system are the perfect chemical isolation from the rest of the cell and the possibility of miniaturization by means of 0.5- to 1.0-mm-OD Pyrex capillaries.

22629 (ANL—86-40, pp B.101-B.114) **Development of the lithium-limited FeS cell.** Kaun, T.D. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The lithium-limited FeS cell (having excess FeS electrode capacity) was the culmination of insights into the operation of Li-Al electrodes and into the performance limitations of the Li-Al/FeS couple. The development of this molten-electrolyte cell (54 wt % LiCl-KCl at 450-470°C) is reviewed. Earlier, a problem with the thin, cold-pressed Li-Al electrodes of the Li-Al/FeS multiplate cell was identified that led to cell-capacity decline rates of 0.1-0.25% per cycle. A change in cell design to reduce the Li-Al capacity utilization to ≦ 60% mitigated the capacity decline phenomenon of the Li-Al electrode. Subsequently, deep-cyclable Li-Al electrodes having 82% utilization of theoretical capacity (85% is considered to be complete utilization of available lithium capacity) were developed with ≦ 0.02% per cycle of capacity-decline rates. The improved Li-Al electrode provided a stepping stone for the development of a lithium-limited FeS cell design. An investigation of

power limitations for the Li-Al/FeS cell revealed a greater than 100% increase in FeS electrode resistivity beyond 60% utilization of its theoretical capacity, which significantly diminished cell power capability. The lithium-limited FeS cell demonstrated an approximate doubling of specific power (100 W/kg) at 80% depth of discharge (DOD) compared with a FeS-limited cell and expanded its usable capacity from 50% to 80% DOD for power-demanding applications. Simultaneously, specific energy was increased about 15% to 100 Wh/kg at a 3-h discharge rate.

22630 (ANL—86-40, pp B.115-B.129) **Electrochemical studies of iron electrodes in sulfide-containing molten salts.** Wang, S.S. (General Motors Research Labs., Warren, MI). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

During testing of a Li-Si/FeS_2 cell, 75% of the cell resistance was detected in the porous FeS_2 electrode. A planar iron electrode was designed to investigate this observation. A molybdenum sleeve, fusion bonded to the iron electrode, was used in combination with boron nitride insulators to provide a uniform primary current distribution. Cyclic voltammetry was conducted on planar iron electrodes in two electrolytes, LiCl-KCl eutectic and potassium-free LiF-LiCl-LiBr. The electrolytes were saturated with Li_2S. Electrochemical reactions with high overpotential, which are responsible for the high resistance of Li/FeS_2 cells, were identified in these electrolytes. It was found that the overpotential of the electrochemical reactions is inversely proportional to the activity of lithium ion in the electrolytes. Some iron-containing compounds, electrochemically formed on the iron electrodes in the potassium-free electrolyte, were found highly soluble in the electrolyte.

22631 (ANL—86-40, pp B.130) **Capacity decline of iron disulfide electrodes in lithium-alloy/metal sulfide high-temperature cells.** Barlow, G. (Gould Inc., Rolling Meadows, IL). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The lithium-alloy/iron disulfide couple has been considered for a molten-salt battery system for many years because of its high theoretical energy density. However, as a practical system it has failed to live-up to its early promise since there is a fairly rapid decay in the capacity of the upper-plateau discharge reaction. Achieving a stable upper-plateau capacity is critical therefore, to further development of the Li-alloy/FeS_2 system for applications which require a long life battery. In-cell experiments utilizing various alkali metal/halide electrolytes with melting points in the range 180-350C have shown that the rate of decline of the upper-plateau capacity is reduced when the cell operating temperature is lowered. However, the cell reaction kinetics are also much slower, particularly at 200C, so that cells have to be operated at lower current densities.

22632 (ANL—86-40, pp B.131-B.137) **Power performance of LiAlSi/(FeNi)S_2 cells.** Redey, L. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Half-cell and model-cell experiments have been conducted to investigate the electrochemical performance of (Fe-Ni)S_2 electrodes and Li-Al-Si/(Fe-Ni)S_2 cells. The electrodes, fabricated with 0.5- to 2-Ah theoretical capacity, have been investigated in both LiCl-LiBr-KBr and LiF-LiCl-LiBr electrolyte in the temperature ranges of 320 to 500°C and 450 to 500°C, respectively. Nickel-sulfide additive was found to improve the kinetics of the FeS_2 electrode. Power performance and charge acceptance of the cell improves to a great extent when Li_2S is used in excess of the stoichiometric amount required by the metal sulfide formation. The presence of lithium sulfide at the end of charge provides a unique overcharge protection mechanism.

22633 (ANL—86-40, pp B.138-B.144) **Stable iron disulfide secondary cell with LiCl-LiBr-KBr electrolyte.** Kaun, T.D. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Results of innovations in the Li-Al/FeS_2 cell are reported. This cell incorporates two major changes from earlier cells of this type: (1) a novel electrolyte, 25 mol % LiCl-37 mol % LiBr-38 mol % KBr (m.p. 310°C) vs. 58 mol % LiCl-42 mol % KCl (m.p. 352°C) and (2) a high loading density (2.4 vs. 1.5 Ah/cm^2) for the FeS_2 electrode, which is then operated only on its higher voltage plateau (1.75 avg. V vs. LiAl). This cell design is designated dense upper-plateau (U.P.) FeS_2 cell to distinguish it from the conventional two-plateau (T.P.) FeS_2 cell. Prismatic bicells (24-48 Ah capacity) of 100-cm^2 separator area (BN felt) were fabricated for evaluating performance and cycle life. Cycle life testing was conducted at 397°C with a 4-h discharge rate (50 mA/cm^2) and 8-h charge rate (25 mA/cm^2). For these conditions, the first cell exhibited 89% utilization of the U.P. FeS_2 electrode capacity, and the voltage/capacity characteristics of the U.P. FeS_2 electrode continued to show virtually no change after 400 cycles (5400 h) of operation. The energy density of this U.P. FeS_2 cell is enhanced as a result of approximately 50% higher utilization of cell capacity and a 10% higher average discharge voltage at 50 mA/cm^2 than a comparable T.P. FeS_2 cell. Specific power at 80% depth of discharge (DOD) is also enhanced by approximately 100% because the cell voltage at that point in the discharge is about 0.3 V higher than that of the T.P. FeS_2 cell with much lower internal cell resistivity.

22634 (ANL—86-40, pp B.145-B.152) **Heat generation in lithium-alloy, iron disulfide, high-temperature batteries.** Gibbard, H.F.; Chen, D.M. (Power Conversion, Inc., Elmwood Park, NJ). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Calorimetric measurements were made of the heat flow from an engineering-scale lithium-(aluminum, silicon)/iron disulfide cell with all-lithium-cation, molten-salt electrolyte during isothermal discharge at various currents. The discharge process was endothermic on the upper (FeS_2) plateau and exothermic on the lower (FeS) plateau. Measurements were made of the open-circuit potential of pellet cells as a function of state of charge and temperature. The temperature coefficient was positive on the upper plateau, and varied from 0.49 mV/K for fully charged cells to 0.74 mV/K for cells discharged by 30 to 50% of their actual capacity. On the basis of work performed at Argonne National Laboratory, these temperature coefficients should correspond to the reaction of FeS_2 to $Li_3Fe_2S_4$ and of $Li_3Fe_2S_4$ to Li/sub 2+x/Fe/sub 1-x/S_2, respectively.

22635 (ANL—86-40, pp B.153-B.161) **Stability of a vitreous electrolyte for possible use in high-temperature lithium/sulfur cells.** Smith, M.L.; Winnick, J.; McLarnon, F.R.; Cairns, E.J. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

A family of lithium-borate glasses has been identified by H. Tuller and coworkers at the Massachusetts Institute of Technology as candidate electrolytes for use in high-temperature Li/S cells. Based upon screening tests, a glass composition (mol%) of 26% Li_2O-7% $LiCl_3$-67% B_2O_3 was selected to exhibit an acceptable ionic conductivity of 3 x 10^{-3} ohm^1 cm^{-1} at 400°C, Tg = 475°C, resistance to attack by S at 400°C, and minimal attack by Li at 350°C. A procedure was developed to form and seal glass tubes, and LiSn/glass/S cells were operated at various temperatures. It was possible to charge and discharge cells at current densities up to 70 mA/cm^2 (for 1-3 min) or 20 mA/cm^2 (for several hours) into the two-phase S-Li_2S/sub x/ region, but the electrolyte tended to fail when the cell was recharged from near the two-phase/single-phase boundary at ~ 73 mol% S. The charge-discharge curves also exhibited hysteresis effects, and a crystalline reaction layer was observed on the S side of the electrolyte tubes. X-ray diffraction anal-

yses suggested that the reaction layer contained crystalline lithium-borate compounds, and static immersion tests showed that the glass was slowly attacked by polysulfides at the 400°C cell operating temperature.

22636 (ANL—86-40, pp C.2-C.11) **Electrode kinetic measurements of very fast reactions: metal deposition-dissolution in molten halides.** Nagy, Z.; Settle, J.L. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Metal deposition-dissolution reactions in molten salts are very fast and difficult to investigate, as evidenced by large discrepancies in the reported exchange current densities. An error analysis of the d-c relaxation techniques was carried out, and it was determined that the measurement of the exchange current density can have a systematic error if the surface reaction rate is much faster than the diffusion rate. This systematic error will result in measured exchange current densities approximately equal to the largest exchange current density measurable under the given conditions. This systematic error can also result in fortuitously linear log i_o versus log C and log i_o versus 1/T plots, even when the results are grossly in error. A computer curve-fitting data evaluation coupled with a statistical sensitivity analysis is suggested to avoid these problems. The exchange current densities of iron, nickel and molybdenum were measured in LiCl-KCl eutectic melt at 450°C using an improved double pulse galvanostatic technique. Only that of iron could be measured reliably (1.7 +/- 0.4 A cm^{-2} at 1.3 x 10^{-6} mol cm^{-3} Fe^{++} ion concentration); the nickel reaction is too fast to be measured (at least 5 A cm^{-2} at 1 x 10^{-6} mol cm^{-3} Ni^{++} ion concentration). The large discrepancies between these results and some results reported by earlier workers can be explained on the basis of the above described error analysis. It is concluded that past experiments resulting in large exchange current densities should be reexamined with improved measuring and data-evaluation techniques because it is possible that the reported values represent only the applicability limit of the measuring technique rather than the true exchange current density.

22637 (ANL—86-40, pp C.12-C.19) **Chemistry and electrochemistry of molybdenum plating from molten salts.** White, S.H.; Twardoch, U.M. (EIC Labs., Inc., Norwood, MA). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The synergism between solution chemistry and the electrode chemistry in electroplating molybdenum is discussed. However, before presenting the results from some basic studies, this specific area of materials processing is placed in the context of electrolytic methods of materials fabrication for use in corrosive environments at elevated temperatures and high potentials. EIC has ongoing programs which are concerned with the development of electroplating refractory metals, in particular those in VIA, chromium, molybdenum, and tungsten from electrolyte operating below 500°C. These metals are of particular interest in view of their high melting points, hardness, and corrosion resistance, particularly at higher temperatures in oxygen free, or reducing environments and/or at high potentials which make them strong candidates as construction materials in new technologies of interest. The ability to electroplate and electroform these metals and their alloys is an important aspect of their successful application for corrosion and erosion protection.

22638 (ANL—86-40, pp C.20-C.32) **Corrosion resistant coatings for high-temperature sulfur and sulfide batteries.** Topor, D.C.; Selman, J.R. (Illinois Institute of Technology, Chicago). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Electrochemical deposition of molybdenum and molybdenum carbide from a molten fluoride (FLINAK) bath at 750-850°C has the advantage of producing dense, stress-free deposits. However, the level of water and hydrolysis products should not be in excess of 100 ppm, thus requiring the use of a dry, inert atmosphere room and a carefully devised drying procedure for the component salts. The electrochemical deposition was carried out in a 3-electrode cell using the potentiostatic mode with current densities 50 to 200 mA/cm^2 during 1 to 2 hours. The molten solvent contained potassium molybdate (5 to 6 w/o) for the deposition of Mo coating or sodium molybdate (4 to 6 w/o) and potassium carbonate (5 to 7 w/o) for Mo_2C coating deposition. The substrate material was low-carbon steel with a nickel interlayer. Both coatings showed good adherence, adequate thickness over edges and corners and a dense structure. Molybdenum and molybdenum carbide coatings exhibit quite similar behavior when cycled between representative anodic and cathodic polarization limits in Na_2S_5 melt at 300°C.

22639 (ANL—86-40, pp C.33) **Techniques for electrodeposition of metals from molten salt systems.** Varma, R.; Vargas, T.; Shimotake, H.; Koyama, K.; Hope, G. 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—).

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

Molten salt offers an alternative to aqueous electrolyte for the electro-deposition of metals. Refractory metals not platable from aqueous electrolyte can be electroplated from molten salt solutions. Metal coatings obtained from molten salt are stress-free, crack-free, nonporous, and strongly adherent to the substrate. Another obvious advantage is the ability to produce hydrogen-free coatings. However, metal deposits from molten salts are prone to be dendritic unless precautions are taken. A common electrolytic medium known as FLINAK (46.5 mol % LiF-11.5 mol % NaF and 42.0 mol % KF) has been used for the state-of-the-art electrodeposition of refractory metals (i.e., Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W). The distinct advantage of the FLINAK process is that it can achieve metalliding (i.e., surface alloying of the depositing metal with the host metal during the electroplating). Nevertheless, the use of FLINAK is sometime restricted because the plating process is conducted at high temperatures (700-900°C) and the mechanical properties of the substrate may be adversely affected. Also the fluoride melts are highly corrosive. The techniques for electrodeposition of refractory metals from molten salt systems are discussed.

22640 (ANL—86-40, pp C.34-C.35) **Future directions in molten salt research as it relates to energy storage.** Cairns, E.J. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A11/MF A01. File Number DE87003297. (CONF-8604116—). Contract AC03-76SF00098.

From International workshop on high temperature molten salt batteries; Argonne, IL, USA (16 Apr 1986).

The future directions for molten salt research relevant to electrochemical energy storage are discussed in several categories, which are found to be in rather different states of maturity. The thermodynamics of the relevant molten salt electrolyte systems and the various electrode systems under serious consideration are in the best state of any of the topics discussed. Many phase diagrams of interest (and potential interest) for molten-salt electrolytes have been measured and calculated. In general, the calculated diagrams agree very well with the measurements, giving confidence that computations, together with only a few measurements can yield high-quality phase diagrams for multi-component alkali-halide systems. The phase diagrams for solid electrodes are generally more complicated and less predictable, but many of them have been measured with good accuracy. Also, the activities of the relevant components have been measured, yielding the essential thermodynamic information. This general topic of electrode and electrolyte thermodynamics is in an adequate state of development. For the future, it is to be expected that more sophisticated thermodynamic models and computational methods will provide for more powerful tools to be used in the estimation of the properties of more complex systems.

22641 (CONF-8610122—11) **Worldwide nickel/iron battery development for electric vehicle applications.** Patil, P.G.; Walsh, W.J.; Miller, J.F. (USDOE, Washington, DC; Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004822.

From 8. international electric vehicle symposium; Washington, DC, USA (20 Oct 1986).

Worldwide efforts to develop Ni/Fe batteries for EV applications are summarized. Research, development, and testing activities in the United States, France, West Germany, Sweden, Czechoslovakia, Russia, Taiwan and Japan are described. Recent technology advances are discussed, and the present state-of-art capability is summarized. Advanced Ni/Fe batteries have exhibited good performance and a service life of 50,000 to 100,000 miles is expected by most developers. Ni/Fe batteries have been tested extensively in electric vehicles in the USA, Japan, Western Europe, and the USSR with generally good results. The present R & D directions of the various developers are described.

22642 **(CONF-8610122—14) Capacity and peak power degradation of lead-acid battery under simulated electric vehicle operations.** Lee, J.; Tummillo, A.F.; Miller, J.F.; Hornstra, F.; Christianson, C.C. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004941.

From 8. international electric vehicle symposium; Washington, DC, USA (20 Oct 1986).

In a program supported by the Electric Power Research Institute, controlled laboratory tests were conducted at Argonne to evaluate the effects of selected EV application factors on the performance and life of the EV-2300 lead-acid battery. These application factors included simulated driving profile discharges with different levels of peak power demands for vehicle acceleration, long rest times after charge or discharge, and different methods of recharging. The performance and life variations among cells and modules in a full-scale battery pack were also examined. Statistical methods were used to analyze the laboratory test data. The key factors affecting the performance and life of the battery were identified, and the rates of capacity and power degradation were quantified using multiple regression techniques. The analyses show that the most significant factors were peak power demand levels and cell location within the six-cell modules. The effects of charge method and rest times were found to be small.

22643 **(CONF-8610122—15) Effect of depth-of-discharge on lead-acid battery overcharge requirements.** DeLuca, W.H.; Tummillo, A.F.; Hornstra, F.; Christianson, C.C. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87004931.

From 8. international electric vehicle symposium; Washington, DC, USA (20 Oct 1986).

To develop an optimal charge procedure, an understanding is needed of the relation between battery available capacity, applied overcharge, and the depth-of-discharge (DOD) level prior to charging. Tests were conducted to measure the charge acceptance of EV-3000 improved lead-acid batteries (which use electrolyte mixing) and ALCO-2200 golf-car lead-acid batteries from initial DOD levels of 25, 50, 75, and 100%. The results show that the charge acceptance of both battery types rapidly declines to zero as a 100% state-of-charge (SOC) level is approached. The overcharge needed to attain the maximum available capacity from an EV-3000 battery is much less than that needed for an ALCO-2200 battery. For the EV-3000, an overcharge of 8% achieves full capacity from an initial 100% DOD level, and a reproducible 99.2% SOC is achievable with only a 6% overcharge from both 75% and 100% DOD conditions. The ALCO-2200 needed an overcharge of about 16% to achieve maximum capacity, but consistently achieved a 99.5% SOC with a 12% overcharge. Less overcharge was needed by the EV-3000 battery to attain maximum capacity from DOD levels of 25 and 50% than was needed from 100% DOD. The overcharge requirement for the ALCO-2200 battery was independent of DOD level. The acquired data, which relate capacity, overcharge, and DOD level, permit the definition of an optimum charge algorithm that ensures the achievement of full capacity without excessive overcharge. Applying only the minimum overcharge level needed for full capacity minimizes battery outgassing, electrolyte water consumption, and maintenance.

22644 **(LBL—22576) The development of a micropatterned electrode for studies of zinc electrodeposition.** Sutija, D.P.; Muller, R.H.; Tobias, C.W. (California Univ., Berkeley (USA); Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87007165.

A micropatterned electrode was prepared for the study of electrocrystallization. Using microphotolithography, in conjunction with evaporation and pulse electrodeposition of thin films, a set of artificially roughened electrodes with hemispherical surface features five microns in diameter was developed. Voltammetric studies were conducted to determine the best electrode material. Gold, platinum, and various carbon surfaces were evaluated for zinc nucleation density and hydrogen overpotential. Surface homogeneity was examined by both light and scanning electron microscopy. Gold was determined to possess the best combination of material properties: chemical inertness, low melting point, and a high work function allowing underpotential deposition of zinc which reduces the rate of hydrogen evolution. Stripping coulometry was employed to determine zinc limiting currents, and evaluate effective diffusion coefficients in concentrated zinc chloride solutions. Although the method worked well for dilute zinc chloride and copper sulfate solutions, it failed at higher current densities; the emergence of surface roughness obscured actual limiting current plateaus.

22645 **Role of water molecules and protons in the active material of nickel positive plate.** Varma, R. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). pp 22-24 of Progress in batteries and solar cells. Cleveland, OH; JEC Press Inc. (1987). Contract W-31-109-ENG-38.

Nickel hydroxide/oxyhydroxide redox couples are the electroactive materials on the positive plate in several alkaline secondary batteries such as nickel-hydrogen, nickel-cadmium, nickel-zinc, and nickel-iron. These much-discussed couples are given in this paper to illustrate the possible redox reactions taking place during charge-discharge of nickel positive plate.

22646 **Electrochemical cell with high discharge/charge rate capability.** Redey, L. (to Dept. of Energy). US Patent Application 6-890,256. 28 Jul 1986. 21p. Contract W-31109-ENG-38. DE87007202 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007202.

A fully charged positive electrode composition for an electrochemical cell includes FeS_2 and NiS_2 in about equal molar amounts along with about 2 to 20 mole % of the reaction product Li_2S. Through selection of appropriate electrolyte compositions, high power output or low operating temperatures can be obtained. The cell includes a substantially constant electrode impedance through most of its charge and discharge range. Exceptionally high discharge rates and overcharge protection are obtainable through use of the inventive electrode composition.

22647 **Bipolar battery with array of sealed cells.** Kaun, T.D.; Smaga, J.A. (to Dept. of Energy). US Patent Application 6-883,216. 8 Jul 1986. 20p. Contract W-31109-ENG-38. DE87007194 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007194.

A lithium alloy/metal sulfide battery as a dipolar battery is disclosed with an array of stacked cells with the anode and cathode electrode materials in each cell sealed in a confining structure and separated from one another except across separator material interposed therebetween. The separator material is contained in a module having separate perforated metallic sheets that sandwich opposite sides of the separator material for the cell and an annular insulating spacer that surrounds the separator material beyond the perforations and is also sandwiched between and sealed to the sheets. The peripheral edges of the sheets project outwardly beyond the spacer, traverse the side edges of the adjacent electrode material to form cup-like electrode holders, and are fused to the adjacent current collector or end face members of the array. Electrolyte is infused into the electrolyte cavity through the perforations of one of the metallic sheets with the perforations also functioning to allow ionic conductance across the separator material between the adjacent electrodes. A gas-tight housing provides an enclosure of the array.

22648 **Lithium disulfide battery.** Kaun, T.D. US Patent Application 6-868,388. 29 May 1986. 24p. Contract W-31109-ENG-38. DE87007183 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007183.

Disclosed is a negative electrode-limited secondary electrochemical cell having dense FeS_2 positive electrode operating exclusively on the upper plateau, a Li alloy negative electrode and a suitable lithium-containing electrolyte. The electrolyte preferably is 25 mole % LiCl, 38 mole % LiBr and 37 mole % KBr. The cell may be operated isothermally.

22649 **Electrochemical cell with high conductivity glass electrolyte.** Nelson, P.A.; Bloom, I.D.; Roche, M.F. (to Dept. of Energy). US Patent Application 6-853,104. 17 Apr 1986. 22p. Contract W-31109-ENG-38. DE87007232 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007232.

A secondary electrochemical cell with sodium-sulfur or other molten reactants is provided with an ionically conductive glass electrolyte. The cell is contained within an electrically conductive housing with a first portion at negative potential and a second portion insulated therefrom at positive electrode potential. The glass electrolyte is formed into a plurality of elongated tubes and placed lengthwise within the housing. The positive electrode material, for instance sulfur, is sealed into the glass electrolyte tubes and is provided with an elongated axial current collector. The glass electrolyte tubes are protected by shield tubes or sheets that also define narrow annuli for wicking of the molten negative electrode material.

22650 **Rechargeable zinc batteries.** McBreen, J. (Brookhaven National Lab., Upton, NY). *Journal of Electroanalytical Chemistry;* **168**: 415-432(1984).

This article reviews the current status of the research and development programs, in the USA, on rechargeable zinc batteries. The review is confined to systems that are now under development. These are the zinc-bromine, zinc-chlorine, zinc-ferricyanide and zinc-nickel oxide systems. Most of the electrochemical problems with these batteries are due to the zinc electrode. Recent advances in zinc batteries include the use of additives and modified charging methods. Recent work by the author and others on the mechanistic of the zinc electrodes in acid electrolytes is discussed and the mechanistic aspects of the effect of additives and charging methods is also reviewed. 48 references, 9 figures, 4 tables.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 24346

22651 (Juel-Spez—291, pp 145-167) **Catalogue of criteria helping to evaluate the consequences of technological developments.** Peters, H.P. Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

In Energy in focus. An intermediate balance of the energy debate.

The catalogue of criteria worked out by the paper abstracted helps to give a systematic and detailed description of the consequences implied by the different alternative energy sources and systems. It particularly allows to evaluate the four energy paths developed by the Enquete Commission. The consequences described refer to energy systems, energy demand, energy supply and the effects of the respective paths on society and individuals. The relevant criteria were chosen with the help of different groups such as trade associations, trade unions or nature protection organizations.

22652 (Juel-Spez—291, pp 181-189) **Four energy paths developed by the Enquete-Commission 'Future nuclear energy policy'.** Grupp, H.; Wagner, H.J. (Deutscher Bundestag, Bonn, Germany, F.R.). Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

In Energy in focus. An intermediate balance of the energy debate.

The Enquete-Commission has definitely agreed upon the four energy paths. The second step intended to work out and evaluate the paths' consequences. However, premature reelections in 1983 impeded its termination. Resolutions could therefore not be adopted and made available. The present state of the studies however allows to catch some tendencies, trends and provisional results. The Commission had already agreed upon the scenarioes to be dealt with in order to evaluate the consequences of energy supply: - economy - environmental compatibility - social compatibility - international compatibility.

22653 (Juel-Spez—291, pp 190-232) **Comprehensive evaluation of the four paths developed by the Enquete-Commission on the basis of a catalogue of criteria.** Renn, O.; Kotte, U. Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

In Energy in focus. An intermediate balance of the energy debate.

The paper abstracted summarizes the evaluation of energy paths and chooses the best energy system or scenario. It discusses environmental effects, effects on health and safety, reliability of supplies, economic effects, international effects, political and social effects and effects on the public.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 22359, 22658, 22663, 23718

22654 **(CONF-861158—5) Energy intensity in manufacturing: Comparison of historical results with forecasts.** Boyd, G.A.; Hochheiser, H.W.; McDonald, J.F.; Ross, M. (Argonne National Lab., IL (USA); USDOE, Washington, DC; Illinois Univ., Chicago (USA); Michigan Univ., Ann Arbor (USA)). 1986. Contract W-31109-ENG-38. 9p. NTIS, PC A02. File Number DE87006961.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

This paper compares several forecasts and their sectoral shift components with those historical analyses and with each other. Specific forecasts are included for: the National Energy Policy Plan - 5 (3) and the related Data Resources Inc. macroeconomic forecasts (5), (NEPP-5/DRI); the 1985 Annual Energy Outlook (6) prepared by the Energy Information Administration (AE085); and the Energy Modeling Forum Study 8 (EMF-8) (Ref. 7) model runs of the Industrial Sector Technology and Utilization Model (ISTUM-II) and the Purchased Heat and Power System (PURHAPS). This paper also draws some comparison across scenarios and between energy models for similar scenarios.

22655 **(CONF-861158—6) Energy intensity of metals manufacturing and effects of changing composition of production.** Boyd, G.; Ross, M. (Argonne National Lab., IL (USA); Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1986. Contract W-31109-ENG-38. 11p. NTIS, PC A02. File Number DE87006979.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

The intensity with which energy is used in manufacturing, i.e., the ratio of energy use (in physical or monetary terms) to production, varies enormously from sector to sector. The subject of this paper is the energy intensity of manufacturing metals and their products. When one groups these manufacturing activities by stage of production one finds a variation in energy intensity of about 30 to 1, declining as one moves downstream with the production process. As a result of this variation, relative shifts in production activity among metals subsectors can have major effects on the overall ratio of energy use to production. One hypothesis we examine is that production is shifting downstream in the manufacturing process with a resulting decline in aggregate energy use per dollar. We also briefly touch on the story behind the downstream shift, i.e., more efficient use of materials and imports of materials. This report grows out of work we did with other collaborators at Argonne on the effect of changes in the composition of production on energy demand for all of manufacturing. After that general analysis we felt a need to relate changes in energy intensity to specific shifts in production and specific changes in manufacturing processes. It is hoped that identification of specific developments important to metals-related manufacturing will be a useful step in the search of

basic explanations of change in energy intensity in all of manufacturing. 10 refs., 5 figs., 3 tabs.

22656 (DOE/EIA—M019) Model documentation for the Mini-Macroeconomic Model: MINMAC. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Mar 1987. 144p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87007101.

The Mini-Macroeconomic Model (MINMAC) is the macroeconomic component of the Intermediate Future Forecasting System (IFFS). It provides forecasts of deviations from a given base case for 19 aggregate macroeconomic variables and many other more detailed sectoral and regional economic variables. These deviation forecasts are utilized by IFFS for energy demand forecasts. Such projections must be repeatedly computed in the course of using IFFS. In the past, such projections were prepared using relatively cumbersome and expensive large macroeconomic models. MINMAC was developed to simplify this computational process and is primarily intended to be used as a module of IFFS. The MINMAC model also includes modules for generating sectoral and regional economic detail. The industrial output module uses relations estimated from historical data to forecast levels of output in 20 manufacturing industries at the 2-digit Standard Industrial Classification (SIC) level, as well as incorporating energy feedbacks into exogenously specified forecasts for certain other sectors needed by IFFS. Output levels for manufacturing, national disposable income, and population forecasts are then allocated to States and regions using shares forecasted by the regional sharing module, based on projections of the Department of Commerce.

22657 (Juel-Spez—291) Energy in focus. An intermediate balance of the energy debate. Albrecht, G.; Stegelmann, H.U. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). Jan 1985. 238p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

Part one of the publication abstracted contains some introductory information about different aspects of energy supply. The publication summarizes a number of papers held in connection with a project dealing with the 'social compatibility of energy systems'. The papers were presented to different groups interested in the subject by technico-scientific experts from university or research institutes. In a popular way the papers discuss the properties of different energy sources and deal with different conversion techniques applied on the electric power and heat market. They point out environmental effects, health and safety risks of energy systems and economic aspects of different energy systems. Part two deals with competing long-term energy systems in the Federal Republic of Germany, that is with the four 'energy paths' of the Enquete Commission. The paths are covering a large variety of feasible developments and trends and therefore reflect all aspects of the energy debate to their full extent.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 22158, 22173, 22174, 22188, 22208, 22209, 22210, 22656, 22769, 23478, 23492, 23534, 23734, 23735

22658 (CONF-861158—7) Estimating a demand model for electricity within a LES [linear expenditure system] framework using nonpanelled cross-section data. Poyer, D. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006980.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

The primary purpose of the research on which this paper is based is to explain variations in the patterns of energy demand and determine the potential consequences that these variations have on economic welfare given different sorts of energy policies. To clearly discern the influence of policy on economic welfare, we have chosen to couch our analysis within a complete demand system. In the process of doing this, we have encountered a number of constraints imposed upon us by the empirical data: we have had either good aggregate time-series data and very little household demographic data or good disaggregated data with good demographic information and very few time points. In this paper, we propose a method of estimating a dynamic LES model using a sequence of cross-section data. This method allows us to use rich information typically contained in cross-section data and at the same time determine a dynamic profile of demand.

22659 (CONF-861158—10) Interactions of energy and the macroeconomy: 95 years of evidence. Santini, D.J. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006982.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

A series of single equation dynamic regression models are constructed to test the hypotheses that both "thermodynamic" and economic efficiency configurations of lagged energy variables are statistically informative about subsequent macroeconomic activity, as represented by changes in real GNP per capita and unemployment rate. The time period tested in most versions of the models is the 1891-1985 period. The "thermodynamic" efficiency (t-efficiency) variable counts changes in the use of per capita energy per unit of national output (real GNP per capita). The economic efficiency (e-efficiency) variable is the more traditional price effect variable, in which changes in the real price of energy are tested for their effect on macroeconomic aggregates. The interactive effects of energy price and quantity shifts relative to macroeconomic aggregates are also assessed by use of a "combined efficiencies" variable which can also be interpreted as a measure of the difference of changes in energy spending and changes in national output. Of the tested energy variables, the combined energy efficiencies variable is clearly the best and most consistent provider of information about future macroeconomic activity. Macroeconomic activity is found to be much less informative about the energy variables than are the energy variables about macroeconomic activity. Consequently one way tests are conducted in which the informativeness of the combined energy efficiencies variable about subsequent macroeconomic activity is compared to the informativeness of money about subsequent macroeconomic activity. These tests infer that both energy and money are important, but that energy is a more consistent performer and better explainer of variation than money. It is also found that the incremental explanatory power of energy improves when it is included in an equation with money, and similarly, the incremental explanatory power of money improves when it is included in an equation with energy.

22660 (PNL-SA—13763) The trade effects of energy use in the US economy: An input-output analysis. Roop, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 6p. (CONF-861158—4). NTIS MF A01; 2; GPO Dep. File Number DE87006438.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

This paper presents an analysis of the effects of trade on energy use in the US economy between 1972 and 1977. A secondary objective is the analysis of energy embodied in merchandise trade over the longer period 1972 to 1984. The first of these relies on an analysis of changes in the input-output (I/O) structure of the economy. Exports and imports are the only components of final demand of interest to this segment of the analysis. A time series of merchandise trade is then substituted for these components and premultiplied by the 1977 total requirements matrix to yield an estimate of the output of US industry through time. Industry outputs are then multiplied by energy intensities and summed to calculate energy use for the economy. The paper is organized as follows: the second section describes the methods used for analysis; the third section reports on the I/O analysis of the trade components of final demand. The fourth section reports the results using the merchandise trade data; the fifth section provides a discussion of both analyses. References are provided at the end of the paper.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 22155, 22197, 22306, 23425, 23427, 23431, 23466, 23478, 23492, 23493, 23495, 23521, 23522, 23533, 23534, 23734, 23735

22661 **(AD-A—175970/3/XAB) Computerization of the Preliminary Pollutant Limit-Value concept. Final report.** Messenger, M.; Pritchard, L.; Sleszynski, H.; Danley, J.; Morgan, M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jun 1986. 18p. (CERL-TR-N—86/13). NTIS, PC A02/MF A01.

The Preliminary Pollutant Limit Value (PPLV) model developed by the U.S. Army Medical Bioengineering Research and Development Laboratory is an attempt to describe the environmental pathways through which humans may be exposed to toxic chemicals that have escaped into the environment. The model estimates the uptake/transformation of the compound at each step in each pathway, and arrives at a preliminary limit value in the environment for the compound of concern based on toxicological considerations. This report describes development of an interactive version of the PPLV model.

22662 **(ANL/EES-TM—323) Environmental trends associated with the fifth national energy policy plan.** Placet, M.; Streets, D.G.; Williams, E.R. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31109-ENG-38. 170p. NTIS, PC A08/MF A01. File Number DE87007531.

This report identifies the current and emerging environmental concerns related to energy and explains how they might be exacerbated or lessened under the conditions described in the reference case of the fifth National Energy Policy Plan (NEPP-V). The analysis includes a quantification of future trends in 18 environmental parameters, including the following: criteria air pollutants (pollutants for which national ambient air quality standards have been set to protect human wealth and welfare): particulate matter, sulfur oxides (SO/sub x/), NO/sub x/, VOC, CO, and lead; hazardous air pollutants (those that can cause serious health effects in specific locales and are regulated under national emission standards for hazardous air pollutants [NESHAP]): radionuclides and benzene only; carbon dioxide (the principal by-product of fuel combustion, which plays a role in changes to the earth's climate); selected water pollutants (regulated under the Clean Water Act): total suspended solids (TSS), oil and grease, and chromium; water consumption; and energy-related wastes disposed of on land: coal-processing waste, flue-gas desulfurization (FGD) waste (sludge), captured fly ash, spent nuclear fuel, and uranium mining and milling waste. The trend projections are generally limited to the quantities of pollutants discharged into the environment at the point of release - for example, at the end of the smokestack. No attempt is made to translate these quantities into the resulting ambient pollutant concentrations, human exposure, or health effects, since such analysis is beyond the scope of this report. However, the qualitative implications of the trends with regard to important environmental issues are discussed. The main findings are described below.

22663 **(CONF-861158—9) An integration methodology applied to the National Energy Policy Plan Environmental Assessment.** Boyd, G.; Kelley, J. (Argonne National Lab., IL (USA); USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Environmental Analysis). 1986. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006962.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

The National Energy Policy Plan (NEPP) Environmental Assessment is part of the congressional mandate required by the US Department of Energy Organization Act. Because energy production, transformation, and use may have the potential to impact the natural environment, the US Department of Energy (DOE) produces a supplement on environmental trends associated with its biannual energy forecast, the NEPP. This paper discusses some of the methodological issues surrounding the preparation of the environmental assessment of the reference case for the fifth NEPP (NEPP-5). The NEPP-5 forecasts energy consumption (or transformation) for several broad sectors. The sectors considered by the environmental assessment are: electric utilities, residential and commercial, industrial, and transportation. In some cases it is necessary to consider specific subsectors of these broader categories, in order to address specific environmental issues. For example, it is necessary to consider the vintages of electricity-generating units to account for environmental regulation. This detail is not provided by the NEPP-5 forecast, and some type of integrating methodology is needed for making the detailed projections.

22664 **(DOE/ER/60273—T1) Report on long-term environmental research and development: [Final report].** (Council on Environmental Quality, Washington, DC (USA)). Mar 1985. Contract AI05-84ER60273. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006297.

Significant gaps in the existing scientific knowledge base cause or exacerbate acknowledged problems of environmental management. Long-term environmental and health research and development (R and D) is needed to resolve these scientific uncertainties, to establish baseline health and environmental parameters, to overcome lack of understanding of short-term variations in natural systems, and to identify long-term trends and relate them to their causes. The Council on Environmental Quality (CEQ) convened a series of four two-day scientific and technical panel meetings to address specific clusters of long-term environmental R and D topics and to discern major scientific issues warranting enhanced government or private sector attention during the remainder of the century. Panelists at each meetings concentrated on a particular research area: human health impacts and their mitigation; geochemical and hydrologic processes and their protection; environmental impacts and their mitigation; and monitoring, assessment, and environmental management.

22665 (ORNL—6353, pp 165-168) **Chemical hazard evaluation program.** Lu, P.Y.; Ross, R.H.; Pruett, J.G.; Hubner, S.M.; Kline, B.W. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The objective of the Chemical Hazard Evaluation Program (CHEP) is to compile, analyze, and disseminate technical information related to health and environmental effects of potential toxic/hazardous substances. The assessment reports and databases produced have been applied to facilitate decision-making processes and enhances research carried out by academia, industries, and governmental agencies.

22666 **(PB—87-129839/XAB) Southeast Chicago study: an assessment of environmental pollution and public-health impacts. Final report.** D'Auben, D. (Illinois Environmental Protection Agency, Springfield (USA). Environmental Programs). Mar 1986. 332p. (IEPA/ENV—86-008). NTIS, PC A15/MF A01.

Southeast Chicago, in the vicinity of Lake Calumet, is a heavily industrialized region that has a long history of serving as a disposal area for a wide variety of industrial, commercial, and residential wastes. In the late fall of 1982, the Illinois Environmental Protection Agency (IEPA) was asked by a citizens group, Irondalers to Abolish the Chemical Threat (I-ACT), to conduct a study of environmental pollution in this area with special emphasis directed toward waste-disposal practices. The final scope of work included a broad range of environmental concerns relating to air, water, and land pollution issues. This scope of work was reviewed and approved by the I-ACT liaison committee. Additionally, as part of the overall effort, an analysis of available health statistics was performed by the Illinois Department of Public Health (IDPH) to determine if cancer rates or the number of birth defects occurring in the area are unusual. The report summarizes the results of these study efforts.

22667 **(PB—87-136743/XAB) Transportation of hazardous materials in Arizona. Volume 1. Comprehensive study approach, analyses and findings.** Pijawka, K.D.; Radwan, A.E.; Soesilo, J.A. (Arizona State Univ., Tempe (USA)). Jan 1986. 175p. NTIS, PC A08/MF A01.

The objective of the study was to assess the magnitude of hazardous-materials shipments, load characteristics in terms of chemical type, volume and hazard class. These data were allocated to routes in Arizona. The analyses is a first step in understanding the hazardous materials transportation situation and will serve as a basis for risk-assessment studies. A database management system was developed for data manipulation and retrieval by state agencies for program planning, risk evaluations, and as a basis for risk evaluations. Several surveys were conducted to obtain the data. These included: (1) hazardous-waste shipments for 1983 and 1984 compiled from RCRA manifests; (2) two one-week surveys of placarded trucks at Arizona's major ports of entry; (3) an intra-state survey at 9 state locations; (4) interviews with distributors of gasoline, acids, and propane.

22668 **(PB—87-136750/XAB) Transportation of hazardous materials in Arizona. Volume 2. Hazardous materials data base management system: development and programs.** Pijawka, K.D.; Radwan, A.E.; Shieh, F.Y.; Soesilo, J.A. (Arizona State Univ., Tempe (USA)). Jan 1986. 80p. NTIS, PC A05/MF A01.

The document describes the steps undertaken to develop the Data Base Management Systems (DBMS) for the transportation of hazardous materials and hazardous wastes in Arizona. It includes the selection of computer hardware and software, the design of the data base input and output form, the development of the necessary command procedures to produce statistical relationships, the step-by-step procedure to access and operate the DBMS, and, finally, the listing of command procedures.

22669 **(PB—87-136768/XAB) Transportation of hazardous materials in Arizona. Volume 3. Executive summary.** Pijawka, K.D.; Radwan, A.E.; Soesilo, J.A. (Arizona State Univ., Tempe (USA)). Jan 1986. 16p. NTIS, PC A02/MF A01.

The objective of the study was to assess the magnitude of hazardous-materials shipments, load characteristics in terms of chemical type, volume and hazard class. These data were allocated to routes in Arizona. The analyses is a first step in understanding the hazardous materials transportation situation and will serve as a basis for risk-assessment studies. A data base management system was developed for data manipulation and retrieval by state agencies for program planning, risk evaluations, and as a basis for risk evaluations.

22670 **(PB—87-139622/XAB) Serious reduction of hazardous waste: for pollution and industrial efficiency.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1986. 262p. (OTA-ITE—317). NTIS, PC A12/MF A01.

Library of Congress catalog card no. 86-600571.

The study explores the context for concern about waste reduction, examines the technological nature of waste reduction and that the extent to which industry has implemented it, analyzes Federal programs and examines State programs for industrial waste reduction and presents policy options that might facilitate implementation of a national waste reduction policy without harming industry.

2904 Natural Resources

REFER ALSO TO CITATION(S) 23140

22671 **(PB—87-139341/XAB) Illinois mineral industry in 1984 and review of preliminary mineral production data for 1985. Illinois mineral notes.** Samson, I.E.; Bhagwat, S.B. (Illinois State Geological Survey, Champaign (USA)). 1986. 54p. (IL/SGS/IMN—95). NTIS, PC A04/MF A01.

The annual output and value of Illinois minerals extracted, processed, and manufactured into products in 1984 are summarized in the report. Materials used in manufacturing were not necessarily extracted within the state. Coal continued to be the leading commodity in terms of value; oil ranked second; stone and sand and gravel ranked third and fourth; fluorspar was fifth. Nationally, Illinois ranked eighteenth in value of nonfuel mineral production. It remained the principal U.S. producer of fluorspar, tripoli, and industrial sand and led in the manufacture of iron-oxide pigments. In stone and peat production, the state ranked fourth. Preliminary data for 1985 indicate that the value of minerals mined was $2,947.8 million, a decrease of 6.1 percent from the $3,138.0 million in 1984. Detailed production summaries and analyses--including maps, tables, and graphs--for all mineral commodities are based on data available for 1984.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 22697, 22773, 23718

22672 **(DOE/EIA—0205(87/1)) Energy information directory, January 1987.** (National Energy Information Center, Washington, DC (USA)). 11 Mar 1987. 96p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. File Number DE87007028.

This directory is a list of many of the government offices that are involved in energy matters. The offices are classified according to their specialities. For the purposes of this publication, each office has been given an alphanumeric identification symbol (A-01, A-02, etc.). The subject index uses these identification symbols instead of page numbers in referring the reader to relevant entries. Most entries provide an abbreviated office address. For the complete address, consult the index of Building Locations. Following the name and title is the DOE routing symbol that refers to the organization; it is part of the mailing address. Because DOE continually undergoes organizational changes, it is possible for the information contained in this directory to have changed by the time it goes to press. The entries are current as of January 30, 1987.

22673 **(ORNL/TM—10232) Research and Development Program Plan for the Center for Engineering Systems Advanced Research (CESAR).** Weisbin, C.R.; Barhen, J.; Hamel, W.R. (Oak Ridge National Lab., TN (USA)). Jan 1987. Contract AC05-84OR21400. 38p. (CESAR—86/47). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005277.

A general framework is provided for more detailed planning on an annual basis, both for DOE and for other sponsoring organizations. The charter for the overall intelligent machine research effort is presented along with programmatic and technological goals. A research implementation plan is provided through the FY 1989 horizon.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 22247, 22248, 22249, 22301, 22306, 22479, 22482, 22684, 22695, 23533

22674 **(AD-A—176021/4/XAB) Preliminary development of a nuclear propulsion officer enlistment supply model. Master's thesis.** Serfass, P.T. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1986. 82p. NTIS, PC A05/MF A01.

This study constructs linear forecasting models, for each of the six Navy Recruiting Areas and the Recruiting Command, that attempt to predict future United States Navy Nuclear Propulsion Officer contracts signed in any one of four fiscal year quarters, given estimates of independent supply variables included in the models. The models are developed using stepwise multiple regression analysis with ordinary least squares and are supported by historical data from fiscal years 1981 through 1985. In developing the models, the thesis examines the relationship between the contracts signed in a given quarter and the following supply variables: number of recruiters, annual goals of number of contracts to be signed, military-to-civilian pay ratio, unemployment rate, size of target population (in the form of market share), advertising and marketing costs and seasonal effects, represented by proxy variables. The assumptions of using multiple regression analysis and linear models are examined through a graphical study of the residuals and do not seem to be refuted. Each of the models are corrected

for first order autocorrelation. Validation of the forecasting models was attempted by the comparison of predicted contracts signed in a quarter against new contract data obtained for fiscal year 1986. The results of the forecasting comparisons are much worse than expected. Possible causes for the large error percentages in the comparisons are mentioned in this study but not examined in detail.

22675 (INIS-mf—10585, pp 2:1-9) **What has happened to the radiation environment after the Chernobyl accident?.** Bengtsson, G. (National Inst. of Radiation Protection, Stockholm Sweden). 1986. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750699. (CONF-8608133—).

From Conference on radiation and health hazards: Chernobyl in perspective; Stockholm, Sweden (28 Aug 1986).

The radiation doses to the general public in Sweden from the Chernobyl accident are discussed. The average dose is estimated to be a few tenth of a mSV during 1986. The highest doses in the most contaminated areas are probably well below the early estimate of 4 mSV for 1986. Some comments are given on the cost benefit aspects on measures to reduce the radiation doses to the public. In all, the measures already taken are judged to be sufficient concerning cesium in the environment and in food. (L.E.).

22676 (INIS-mf—10585, pp 3:1-10) **Why do we have such different opinions?.** Westermark, T. (Royal Inst. of Tech., Stockholm Sweden). 1986. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750699. (CONF-8608133—).

From Conference on radiation and health hazards: Chernobyl in perspective; Stockholm, Sweden (28 Aug 1986).

There exist very wide differences in peoples appreciation of the health risks due to radiation in e.g. the Chernobyl accident. The causes for such differences are discussed in this article, like the low dose controversy, the subject risk perception a.o. (L.E.).

22677 (Juel-Spez—291, pp 62-78) **Nuclear power.** Wolters, J.P. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Nukleare Sicherheitsforschung). Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

In Energy in focus. An intermediate balance of the energy debate.

Nuclear power is meanwhile covering 17 per cent of the annual electric power consumption of the Federal Republic of Germany. The paper abstracted gives a general description of nuclear power plants, their constructional and operational features and different methods of radioactive waste disposal. Moreover, the paper discusses the frequency distribution of early deaths per year referring to 25 plants as well as the empirical values of diseases (leukemia, cancer) caused by reactor accidents and depending on the distance kept referring to one plant.

22678 (Juel-Spez—291, pp 79-88) **Nuclear power - an out-of-date perspective.** Mueller-Reissmann, K.F. (Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung, ISI, Karlsruhe, Germany, F.R.; Institut fuer Angewandte Systemforschung und Prognose, ISP, Hannover, Germany, F.R.). Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

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In view of the meanwhile obviously limited ecological, social and psychical capacities it is necessary to abandon and break with the concept of progress and growth. With respect to future energy supply the paper points out that the extension of nuclear power is absorbing too much capital, too much scientific and technological know-how, political interest and capacity to learn and therefore complicates the necessary ecological reorganization of energy supply.

22679 (Juel-Spez—291, pp 89-100) **Nuclear power - a reliable contribution to present and future energy supply.** Muench, E. Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

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Nuclear power may be considered a technically developed energy source whose application has so far been resulting in extraordinarily positive balances. It makes power generation a most economic process and may be considered a low-pollution technology compared with other methods of electric power generation. Due to technical and organizational measures the nuclear risk is controllable. The remaining risk is by all means smaller than that of other technical installations. Its future prospects are promising in what concerns the improved utilization and exploitation of raw materials by means of the fast breeder and the intensified participation in the heat market due to process heat production by means of the high temperature reactor. In view of the social, political and international effects and upon the weighing of all advantages and disadvantages nuclear power may doubtlessly be considered a socially compatible technology.

22680 **(NUREG—0750-Vol.24-No.2) Nuclear Regulatory Commission Issuances, August 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Aug 1986. 207p. NTIS, PC A10/MF A01 - GPO. File Number TI87900548.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 22695

2910 Conservation

REFER ALSO TO CITATION(S) 22685, 22696, 22705, 22773, 22776, 22778, 22779, 22780, 22781, 22786, 23427

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 22207, 22359, 22654, 22656, 22657, 22690, 22696

22681 **(DOE/EIA—0383(86)) Annual energy outlook, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 11 Feb 1987. 74p. NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. File Number DE87006841.

The forecast summary highlights the principal components of the Energy Information Administration's projections of energy supply, demand, and prices. Key issues are addressed for each of the major energy markets (petroleum, natural gas, coal, and electricity), along with the developments anticipated for end-use energy consumption and new technologies. The overview lists the principal conclusions followed by discussions of the important elements of the projections. This information revises production forecasts for 1986, 1987, and 1988, but its effect on later years should be much less, because some portion of the production fall amounts to production delays (Table 1). Lower well completions and delayed work-overs remove production from significantly sized wells, but little of this production is lost permanently. To the extent that higher prices encourage higher development activity, well completions and work-overs should resume at a more normal level. In the short run, shut-in wells, which are mostly marginal stripper wells, can also be returned to production. With the liberalization of State and Federal regulations on when shut-in wells must be permanently abandoned, a window of about one year exists during which these stripper wells can be restored. Some of these wells will never resume production, but with prices in the $18 plus range, most will again be economic.

22682 (Juel-Spez—291, pp 15-27) **Essential aspects and concepts of the energy debate.** Kotte, U. Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

Sozialvertraeglichkeit von Energieversorgungssystemen.

In Energy in focus. An intermediate balance of the energy debate.

The paper abstracted intends to elucidate the structures of modern energy supply and explains a number of concepts arising in the energy debate. Among others, the paper discusses the different energy sources, the relation between per capita income and primary energy consumption, the development of primary energy consumption classified by energy sources, economic growth and electric power consumption in the Federal Republic of Germany and end use energy consumption classified by different groups of consumers.

22683 (Juel-Spez—291, pp 168-180) **Scenarios of energy supply - the feasibility of optimal combinations.** Renn, O. Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

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In Energy in focus. An intermediate balance of the energy debate.

Energy services include - space heating supplies for heating purposes and tap water - the supply of high temperatures for industrial processes - the supply of electricity and power for engines and lighting. The services may be made available by way of combining different energy systems. The individual systems to be participating in central supply systems may not be chosen randomly. Some of the individual systems do not meet the requirements of certain services or, in case they do, go hand in hand with extremely high costs. Besides, some of the systems depend on others or partially exclude one another. As some combinations may always be worse or better than others it is necessary to not only cope with the consequences of individual energy systems but also with the implications of central supply systems.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 22208, 22209, 22247, 22248, 22249, 22659, 22662, 22663, 22696, 22814, 22815, 24325

22684 **(IEAL-R—86-65-Vol.1) Spent fuel management strategies in eight countries and applicability to Sweden. Final report. Description of spent fuel management activities in each country and applicable laws and regulations .** (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). 29 Oct 1986. 304p. NTIS (US Sales Only), PC A14/MF A01. File Number DE87750700.

International Energy Associates Limited undertook this study on behalf of Sweden's National Board for Spent Nuclear Fuel. The purpose of the project was to compare the programs and regulations for the management of spent fuel from nuclear power plants in eight countries: Belgium, Canada, the Federal Republic of Germany, France, Japan, Switzerland, The United Kingdom and the Uinted States. The study is presented in three volumes. Volume I consists of detailed country-specific reports on the policies, regulations, and strategies for spent fuel and high-level waste management in each of the eight countries.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 22155, 22172, 22173, 22174, 22188, 22192, 22193, 22195, 22199, 22207, 22208, 22209, 22210, 22657, 22671, 22695

22685 **Energy security and end use: Efficiency and fuel switching.** Fulkerson, W.; Carlsmith, R.S. (Energy Div. at Oak Ridge National Lab.). pp 103-144 of Improving US energy security. Bethesda, MD; Atomic Industrial Forum (1985).

Efficiency improvement is equivalent to being smarter about energy use. From the point of view of the authors' discussion, the difficulty with this ideal definition is separating the effects of efficiency improvement as defined from those due to other causes. These other causes could include deprivation or curtailment; substitution of increased labor; changes in lifestyle, comfort, safety, product mix, or aesthetics; or spending more time than is warranted on the basis of minimizing discounted life cycle costs. Generally, when discussing aggregate results for economic sectors or the nation as a whole, the authors use energy intensity or productivity (e.g., energy use per unit of output or activity) as a measure of efficiency. On the other hand, when discussing specific technologies, they find it possible to come closer to using their ideal definition. The authors define fuel switching as the change with time in the ratio of oil use to total energy use, and for a particular time period define a fuel-switching index or FSI.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 22353

22686 **(PB—87-130589/XAB) Development of synthetic gasoline production process.** Imai, T.; Fujita, H.; Yamada, K.; Suzuki, T.; Tsuchida, Y. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1986. 9p. NTIS, PC PC E06/MF E01.

Included in Mitsubishi Juko Giho, Vol. 23, No. 4, 97-104(1986).

As oil deposits are limited, it is very important to develop techniques for manufacturing petroleum alternatives as substitute energy sources to brighten the outlook for the future. The Research Association for Petroleum Alternatives Development (RAPAD) in Japan is engaged in the research and development of production techniques for light hydrocarbon oils such as gasoline, kerosene, and light oil from synthesis gas (CO, H_2) obtained from the raw materials of natural gas, coal, etc. Regarding the MTG process of synthesizing gasoline via methanol from synthesis gas and the STG process of directly synthesizing gasoline from synthesis gas, Cosmo Oil Co., Ltd. and Mitsubishi Heavy Industries, Ltd., members of RAPAD, have sought jointly to develop catalysts and processes. As a result of this co-operation, the authors have recently succeeded in developing a new catalyst with a long life span capable of providing a high yield and high selectivity. Additionally, the authors are currently on the verge of putting into effect a unique two-step STG process of synthesizing high octane gasoline via dimethyl ether, referred to as the AMSTG process.

2960 Electric Power

REFER ALSO TO CITATION(S) 22658, 22681

22687 **(DOE/CE/27460—T23) ACEEE [American Council for an Energy-Efficient Economy] 1986 summer study on energy efficiency in buildings: Volume 8, Proceedings from the panel on planning/forecasting.** (American Council for an Energy-Efficient Economy, Washington, DC). Aug 1986. Contract FG01-86CE27460. 243p. American Council for an Energy-Efficient Economy, 1001 Conn. Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005154.

Nineteen papers are included on energy efficiency in buildings, utility planning, and energy demand forecasting. (DLC)

22688 **(DOE/EA—0323) Environmental assessment for 1987 BPA wholesale power and transmission rate filing.** (USDOE Bonneville Power Administration, Portland, OR. Office of Power and Resources Management). Feb 1987. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006592.

This Environmental Assessment (EA) identifies and discusses, pursuant to the National Environmental Policy Act (NEPA) and related Department of Energy procedures, the potential environmental effects of the Bonneville Power Administration's (BPA) proposed 1987 wholesale power and transmission rates. The effective period of the rates, if approved, would be Federal fiscal years (FY) 1988 and 1989 (October 1, 1987 through September 30, 1989). The proposed rates could be in effect for a longer period if BPA determines that its revenues under the proposed rates will be sufficient to meet its obligations beyond FY 1989.

22689 **(DOE/EIA—0226(86/2)) Electric power monthly, December 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 10 Mar 1987. 49p. NTIS, PC A03 - GPO. File Number DE87004258.

Net generation from nuclear-powered units reached a record high of 39,470 gigawatthours in December 1986, nearly 2000 gigawatthours more than the previous 1-month record for nuclear-powered net generation, which occurred in August 1986. Net generation from nuclear energy in December 1986, represented 18.5% of the total electricity produced during the month. This is the largest percentage share of total generation from nuclear units for any single month. Although the nuclear generation level was 17% higher in December 1986 than in December 1985, the total generation level was almost 3% lower. Electric utilities also reported lower coal- and gas-fired generation. Coal net generation in December 1986 was 118,359 gigawatthours, 7% lower than for the same month a year ago, and gas net generation was 16,845 gigawatthours, 16% lower.

22690 **(DOE/IR/04167—T1) Electrical energy: Policy and prospects: [Final report].** (Pennsylvania Dept. of Education, Harrisburg (USA)). [1987]. Contract AC05-76IR04167. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006260.

Although this text deals with electrical power, some discussion of other aspects of energy are necessary to see how electricity fits into the total energy picture. Thus some chapters are more general in nature, while others relate directly to electrical power. The chapter on nuclear power is longer than other chapters. This is not meant to emphasize that particular method of electrical generation, but is intended to help the reader understand the complex and controversial issue of nuclear power. Some portions of the text, such as those dealing with energy policy, will be quickly out of date. This is an unavoidable problem in an area where events are continually unfolding, but the information that is presented can still serve as a background against which to view current energy news.

22691 **(EPRI-EM—5038) Price elasticity variation: An engineering-economic approach: Final report.** Sathaye, J.; Kahn, E.; Robbins, D. (Lawrence Berkeley Lab., CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. Contract AC03-76SF00098. 107p. NTIS, PC A06/MF A01 - RRC, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87006952.

This report discusses variable elasticities and an engineering-economic approach to estimating elasticity in the residential sector. The report is in two parts. The first part includes a discussion of the factors that affect price elasticity estimates, a survey of estimates of price elasticities in the residential sector from 1978 to 1982, and a critical evaluation of interesting and controversial studies during this period. The second part of the report is an application of engineering-economic methods to estimate long and short run price elasticities in the residential sector. The elasticities were estimated using data for Gulf States Utilities Company, based in Beaumont, Texas. The price forecast used in our analysis, to estimate future residential electricity demand, is one of the many forecasts that the utility company uses for analysis purposes, and should not be construed as an official company forecast of electricity prices. Our short run model examines how income, prices, and other independent variables influence capacity utilization of appliances rather than electricity demand. Long run elasticity is estimated using an engineering economic approach, by combining our estimate of short run elasticity with projections of stock changes.

22692 **(EPRI-EM—5065) Moving toward integrated resource planning: Understanding the theory and practice of least-cost planning and demand-side management: Final report.** Gellings, C.W.; Chamberlin, J.H.; Clinton, J.M. (Electric Power Research Inst., Palo Alto, CA (USA); Barakat, Howard and Chamberlin, Inc., Berkeley, CA (USA)). Feb 1987. 96p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920293.

Least-cost planning and demand-side management are two approaches to developing electric utility plans that explicitly address customer energy-use alternatives. This study explores the similarities and differences between these two methods and describes a new approach incorporating the best features of each.

22693 **(EPRI-P—5046) Developing competitive power production strategies for existing power plants: Final report.** Wayland, R.E.; Brusger, E.C. (Temple, Barker and Sloane, Inc., Lexington, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 61p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920296.

As electricity markets become more competitive, utilities can maintain market share and provide value to their customers by developing strategies that optimize the productivity of their existing power plants. This study produced a conceptual framework for analyzing competitive production strategies.

22694 **(EPRI-P—5061) An examination of models of issue development: Environmental scanning using on-line databases: Final report.** Clabaugh, G.T.; Hallett, J.J. (Trend Response and Analysis Co., Inc., Alexandria, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 171p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920294.

Examining the evolution of six environmental issues over a ten-year period, this study investigates the dominant theories of issue development and the applicability of on-line information sources to the issues management process. The research methodology used was a form of content analysis known as bibliometric analysis. Six environmental issues (acid rain, PCBs, thermal pollution, groundwater contamination, leaking underground storage tanks and leachate) were selected for a retrospective analysis of their evolution as public issues. Their evolution was tracked through the scientific, popular, legislative and national press, then compared to existing models of issue development. The research was conducted using a high-speed proprietary software program, and was based on how often the chosen issues were mentioned in selected databases. The rise and/or fall in frequency for each issue was charted and the resultant patterns were compared to theoretical models. More than 20 million articles from 24 databases were individually scanned for mentions of the issues, and efforts were made to find patterns in their growth and evolution. Charts and graphs of the results were generated and analyzed. A number of questions were raised about the use of computers and on-line information as issues management tools, plus suggestions for future research.

22695 (Juel-Spez—291, pp 130-141) **Electric power generation in large-scale power plants.** Wolters, J.P. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Nukleare Sicherheitsforschung). Jan 1985. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87751334.

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Future electric power consumption will be depending on the economic development of the Federal Republic of Germany. Thermal power plants are fueled with non-renewable energy sources, i.e. coal, petroleum, natural gas or nuclear power. It is therefore important to assess the global coverage of these energy sources and to take stock of the reserves of the Federal Republic of Germany. If the waste heat left from electric power generation was made use of in dual-purpose power plants total energy consumption could be considerably reduced. Large-scale power plants do have to face and cope with the lack of distribution networks to supply the consumer.

22696 **Electricity, productivity, and fuel substitution.** Weinberg, A.M. (Institute for Energy Analysis, Oak Ridge Associated Universities). pp 85-102 of Improving US energy security. Bethesda, MD; Atomic Industrial Forum (1985).

At the Institute of Energy Analysis (IEA), the authors have examined the energy efficiency of electricity in various heavy industries - steel, pulp, and paper; petroleum; and glass. In general, they find that electricity often proves to be more energy efficient and much more productive at the point of end use than gas and oil.

The high efficiency is related to electricity's precise controllability; its capacity to produce extremely high temperatures; its small environmental impact at point of end use; and its versatility as a source of heat light, mechanical drive, and electrochemical potential. Will there be enough electrical capacity to provide for "normal" economic growth, let alone substitution of electricity for oil? The authors present projections made in July 1982 by the Electric Power Research Institute (EPRI) for the year 1991.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 22194, 22777, 22785

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 22359, 22657

22697 **The development of renewable energy sources in the light of surplus energy.** Hay, J.; Hulstrom, R. (Univ. of British Columbia). pp 2634-2636 of Proceedings of the ninth biennial congress of the International Solar Energy Society. Bilgen, E.; Hollands, K.G.T. Elmsford, NY; Pergamon Books Inc. (1985). (In French)(CONF-850604—).

From INTERSOL '85 - Solar energy--the diverse solution; Montreal, Canada (23 Jun 1985).

This paper considers energy source development in the context of supply and demand. Topics covered include technology transfer, meteorology, solar architecture, information dissemination, measuring instruments, buildings, daylighting, and insolation.

30 DIRECT ENERGY CONVERSION

3005 Fuel Cells

22698 **(PB—87-130167/XAB) Development of molten carbonate fuel cell at IHI (Ishikawajima-Harima Heavy Industries).** Nakazawa, K.; Yoshida, T.; Koga, M.; Sato, S.; Nikai, I. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1986. 13p. NTIS, PC PC E04/MF E01.

Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 19, No. 3, 105-117(1986).

IHI started development work on a molten carbonate fuel cell (MCFC) in 1983. During the last three years, development efforts resulted in fruitful achievements and its technology reaches at the world's MCFC development forefront. Development of the MCFC system requires such core technologies as related to (1) chemical reaction, (2) raw materials, and (3) high temperature, together with these, IHI has other excellent basic technologies to constitute the MCFC. Moreover, IHI is now planning to materialize the actual application of the MCFC to the power generation in the future. Three major technologies developed by IHI will greatly contribute to realization of the MCFC; they include (1) the tape cast method for wider electrolyte plate production, (2) parallel-flow-type stack structure with an internal manifold and (3) the technology to clarify the mechanism of heat-transfer inside the cell.

22699 **Molten carbonate fuel cell reduction of nickel deposits.** Smith, J.L.; Zwick, S.A. (to Dept. of Energy, Washington, DC). US Patent 4,643,955. 17 Feb 1987. Filed date 27 Jun 1985. vp.

A fuel cell is described comprising a porous anode, a transition metal-based porous cathode separated from the anode, means for directing a hydrogen-affording fuel gas to the anode and an oxidant including oxygen gas to the cathode, and an electrolyte component between the anode and cathode including an alkali metal carbonate as an electrolyte, a first gas-impervious tile member adjacent the anode and a second gas-permeable tile member adjacent the cathode. Both tile members have small pores containing the carbonate electrolyte with the second tile member having an interior and including interconnecting larger pores extending into the interior. The larger pores are arranged for receiving oxygen gas and provide an oxidizing environment within the second tile. The second tile member has an ionic resistance per unit thickness greater than that of the first tile member.

22700 **Device for equalizing molten electrolyte content in a fuel cell stack.** Smith, J.L. (to Dept. of Energy, Washington, DC). US Patent 4,643,954. 17 Feb 1987. Filed date 23 Dec 1985. vp.

A device is described for equalizing the molten carbonate electrolyte content along the height of a fuel cell stack, with a voltage gradient of negative and positive polarity. The stack has a manifold for reactant gas communicating with a stack face and a porous sealing member in sealing relationship between edges of the manifold and the stack face. The device comprises: a passageway for electrolyte flow having a first end portion adjacent to the negative end and a second end portion adjacent to the positive end of the stack height; a first porous ceramic wick, wettable by molten carbonate electrolyte, extending from the porous sealing member into the first end portion of the passageway adjacent to the negative end of the stack; a second porous ceramic wick, wettable by electrolyte extending from the porous sealing member into the second end portion of the passageway adjacent to the positive end of the stack; and means for vaporizing molten carbonate electrolyte in the first end portion of the passageway, and means for condensing the carbonate electrolyte vapor in the second end portion of the passageway to return molten carbonate to the positive end of the cell stack.

22701 **Cathode for molten carbonate fuel cell.** Kaun, T.D.; Mrazek, F.C. (to Dept. of Energy). US Patent Application 6-855,548. 25 Apr 1986. 12p. Contract W-31109-ENG-38. DE87007238 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007238.

Disclosed are a porous sintered cathode for a molten carbonate fuel cell and method of making same. The cathode includes a skeletal structure of a first electronically conductive material slightly soluble in the electrolyte present in the molten carbonate fuel cell covered by fine particles of a second material of possibly lesser electronic conductivity insoluble in the electrolyte present in the molten carbonate fuel cell. The cathode has a porosity in the range of from about 60% to about 70% at steady-state cell operating conditions consisting of both macro-pores and micro-pores.

22702 **Corrosion of iron in molten carbonates at 650°C.** Hsu, H.S.; De Van, J.H.; Howell, M. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). pp 285-305 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—). Contract AC05-84OR21400.

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

In order to define and study the mechanisms that control the corrosion of current collector materials in molten carbonate fuel cells, the corrosion of iron with Li/sub 2/CO/sub 3/-K/sub 2/CO/sub 3/ melts was investigated. Thermochemical calculations were used to identify equilibrium corrosion products and establish phase stability diagrams for the Fe-Li-K-C-O system at 650°C. With the aid of these phase stability diagrams, the corrosion kinetics and scale morphologies were examined. The corrosion of iron with a 2.0-mg/cm/sup 2/ carbonate deposit under 20% O/sub 2-/(0.01-50)% CO/sub 2/-Ar proceeded according to a parabolic rate law. The corrosion rate was controlled by the diffusion of iron cations through FeO and Fe/sub 3/O/sub 4/ inner layers. The formation of a porous LiFe/sub 5/O/sub 8/-Fe/sub 2/O/sub 3/-KFeO/sub 2/ outer layer explained the difference in reaction rates between the corrosion of iron with the carbonate and the oxidation of iron. The corrosion of iron with the carbonate deposit under PO/sub 2/ < 0.1 atm followed a linear rate. The controlling step was the time required for dissolving oxygen from the gas phase into carbonate. In the latter condition the corrosion of iron with a carbonate film was much slower than the oxidation of iron.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 23431

22703 **(DOE/CE/20126—T8) Assistance in planning and analysis and in preparing the Energy Conservation Multi-Year Plan: Technical progress report.** (Energetics, Inc., Columbia, MD (USA)). 18 Mar 1987. Contract AC01-86CE20126. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006174.

The Office's activities focus on research, technology development, information dissemination, technology transfer, energy management in the federal establishment, energy-related guidelines and standards, etc. This plan covers FY 1988-1992. (DLC)

22704 **(DOE/OR/21400—T294) ORNL research programs on conservation technologies.** Carlsmith, R.S. (Oak Ridge National Lab., TN (USA)). 11 Mar 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006622.

The Energy Conservation research at ORNL includes projects aimed at improving the efficiency and competitiveness of all sectors of the US economy. Approximately 100 engineers and scientists from the staff are assigned to the Conservation Program, 29 additional on the closely related Renewable Energy Program, together with equal numbers of supporting staff. In addition, we subcontract substantial portions of the work (about 50%) to universities and industry in order to utilize experts on each topic and also to obtain the involvement of the eventual users of the technologies at an early stage.

22705 **(PB—87-137204/XAB) Planning for energy conservation R and D: a review of the DOE's (Department of Energy's) planning process. Final report.** (National Research Council, Washington, DC (USA)). 1986. 117p. NTIS, PC A06/MF A01.

Since 1981, the Department of Energy (DOE) has spent over one billion dollars in support of research and development to enhance energy efficiency in industry, buildings, and transportation. In 1984 the Deputy Assistant Secretary for Conservation initiated a multi-year planning process in which on-going programs were assessed, adjustments made, and a five year projection of federal support for research and development programs is articulated. While the new planning process has been effective, the DOE requested a critique of it's planning process and recommendations on ways to strengthen the plan. In response to this request, the Committee was formed to critique DOE's planning process for federally sponsored research and development. The report analyzes the legislative context, the process of management, and the degree to which the resulting portfolio is related to conservation goals and objectives.

3201 Buildings

REFER ALSO TO CITATION(S) 22212, 22385, 22687, 23109, 23427, 23466

22706 **(BNL—38790) The Danish house at the Brookhaven International Housing Village first year's preliminary results.** Loss, W.; Jones, R.; Cerniglia, P. (Brookhaven National Lab., Upton, NY (USA)). Aug 1986. Contract AC02-76CH00016. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007154.

Results from monitoring the energy balance of the Danish house are presented. A performance monitoring program developed at the Solar Energy Research Institute was used. Its purpose is the calculation of monthly building energy balances. Thermal storage effects are excluded and it makes no attempt to determine the building's thermal processes in detail. Hence, the instrumentation is limited and the building is reduced to a one-zone structure.

22707 **(DOE/BP—803) Energy and indoor air quality measurements from five energy conserving manufactured homes: Final report, 1987.** Lee, A.D.; Taylor, Z.T.; Parker, G.B.; Wilfert, G.L.; Callaway, J.W.; Onisko, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 106p. NTIS MF A01; 2; GPO Dep. File Number DE87007039.

The objectives of this study are to (1) determine whether manufactured homes built to the Pacific Northwest Model Conservation Standards (MCS) perform according to the energy requirements of the standards, (2) determine air exchange rates in these homes, (3) determine whether indoor air pollutants exceed specified levels in these homes, and (4) provide information useful in future efforts to encourage the production of energy efficient manufactured homes in the Pacific Northwest. The study has been conducted by Pacific Northwest Laboratory (PNL) for the Office of Conservation, Bonneville Power Administration (BPA). The project constitutes one case study conducted in conjunction with the BPA-sponsored End-Use Load and Conservation Assessment Program (ELCAP).

22708 **(DOE/BP/18690—2) Relationship of the new homes resource to Bonneville Power Administration's 1986 resource strategy.** Foley, L.O.; Wilfert, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006884.

The 1986 Resource Strategy is a proposal that results from Bonneville Power Administration's (BPA) annual resource planning cycle. It is primarily a decisionmaking tool designed to help BPA determine how to best meet its future load obligations and to provide guidance for program levels for the budget period. This report describes that proposal and the considerations and issues that go into developing the Resource Strategy, and specifically focuses on how the new homes resource (savings from the Model Conservation Standards proposed by the Northwest Power Planning Council) fits into BPA's resource strategies. The report also includes a brief review of the Council's resource strategies to meet load and how the MCS fits into its strategies. The goal of the Resource Strategy is to ensure that BPA provides its customers reliable service at the lowest possible cost while balancing different types of economic and programmatic effects. It specifies the conservation and generating acquisition activities that the agency plans to undertake in the next 3 to 5 years to meet its load obligations. In summarizing these activities, this report includes a brief, generic discussion of cost-effectiveness as it relates to the Resource Strategy, a description of the existing regional electrical system and how its characteristics affect both the choice and the timing of additional resources, and a discussion of how BPA selects the resources (e.g., their forecasts, analysis, and models) and how the resources come together to serve forecasted future loads.

22709 (DOE/CE/27460—T5, pp 3.7-3.19) **Improved building energy efficiency through integrated architecture and engineering research and education.** Bales, E.; Hawk, D. (New Jersey Institute of Technology, Newark). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

Achieving energy efficient buildings is important to both architects and engineers. Areas of overlap exist in how each profession works towards this common objective, but there are differences that lead to tensions and lost opportunities. One major opportunity is achievement of total building performance. Each profession has different responsibilities, competencies and viewpoints about energy efficiency. This frequently results in contradictory work. Architects generally see energy efficiency in terms of envelope and spatial organization. The engineer sees it in terms of discrete technical systems design. From this basis there is little change to rise above the limits in each approach, and tap into the considerable potentials for systematic energy efficiency through interdisciplinary research. This tradition of building research has not encour-

aged integration of either the process or products of building production. In addition to a new research framework, a new relationship among the many building design disciplines is needed. With this, a significant leap forward in building technology can be made. An alternative approach is outlined in this paper. Innovative applications of advanced technologies are an important part of the approach. Energy has led the way into technological advances over the past decade and will probably continue to be an important driving force for several decades to come.

22710 (DOE/CE/27460—T5, pp 3.20-3.30) **Administration of small energy conservation projects in commercial buildings.** Blumstein, C.; Keilch, P. (Univ. of California, Berkeley). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The administration of small energy conservation projects (i.e., projects costing between $1000 and $20,000) can present a difficult challenge for those responsible for energy management in commercial buildings. In order for small projects to remain cost-effective, administration costs must be held down, but small projects are often nearly as complicated as larger projects. Thus, when the city of Berkeley obtained $225,000 for the purpose of undertaking a number of small energy conservation projects, it quickly became clear that the efficient use of limited administrative resources would be very important. This report describes Berkeley's strategy for project administration and discusses some of the problems associated with this strategy. A central feature of this strategy was the use of combined audit - design - construct - maintain contracts. They conclude that contracts of this type can be used successfully provided that a careful, independent technical review is conducted in each phase of the contract. They also report some of the savings obtained in the few months since the completion of the projects.

22711 (DOE/CE/27460—T5, pp 3.31-3.42) **Future directions of commercial energy research: a utility perspective.** Buller, S.M. (Pacific Gas and Electric Co., San Francisco, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The shift toward increased importance of customer orientation in planning created a need for more customer data. In the last ten years utilities have conducted mail surveys, on-site surveys, and even some end-use metering projects. Data analysis has included end-use forecasting models, conditional demand analyses, load shape analysis, market research, and program planning and evaluation. These analyses, however, have only scratched the surface in providing the utility with necessary information about its customers. The analysis that answers one question spawns others. Utilities operate in an increasingly competitive market place. Reliable data about such things as customer choices, available alternatives, and market penetration of the alternatives are crucial in order to survive in the increasingly deregulated environment. Now that utilities are realizing what is possible, it is time to assess what is needed, to ensure the highest value for the research dollar.

22712 (DOE/CE/27460—T5, pp 3.43-3.62) **Determining electrical demand savings for small commercial buildings with overnight storage of chilled water a simplified procedure for preliminary economic analysis.** Chaddock, J.B.; Sud, I. (Duke Univ., Durham, NC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

Small commercial and institutional buildings are a prime target for reducing electrical demand through chilled water storage. To determine the economic benefit from the reduced chiller size and electrical demand, a detailed engineering analysis of the month-by-month cooling loads with and without thermal storage is required. For small buildings the design budget and engineering skills may be so limited as to discourage such analysis. This paper develops a simplified procedure using nomograms to quickly estimate the reduced chiller size, storage capacity and monthly electrical demand savings which will result for a continuously operated chiller with nighttime storage.

22713 (DOE/CE/27460—T5, pp 3.63-3.76) **Experiences during the first year of operation of three low-energy apartment buildings, a part of the Stockholm project.** Cleary, P.; Elmroth, A.; Hambraeus, M. (Royal Institute of Technology, Stockholm, Sweden). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

One of the aims of the Stockholm project is to construct comfortable apartment buildings which consume less than 100 kWh/m2-year of bought energy during a normal year, almost half the consumption of a normal new building. Three of the Stockholm project buildings, namely Konsolen, Kejsaren and Sjukskoeterskan, were ready for occupancy in 1984. Their first year of operation was planned as a shakedown period during which both the buildings and their computerized monitoring systems could be brought up to the best possible running order. An overview of experiences during this first year is presented for each building. The shakedown has proceeded differently in the various buildings, since Konsolen has high mass and an exhaust air heat pump, Kejsaren has a solar collector and a warm air heating system, and Sjukskoeterskan is almost conventional except for unusually thick insulation and a balanced mechanical ventilation system with an air-to-air heat exchanger.

22714 (DOE/CE/27460—T5, pp 3.77-3.90) **Energy savings in retrofitted multi-family buildings: new results from the BECA-B project.** Goldman, C.A.; Greely, K.M. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The authors compile and analyze measured data on 141 retrofit projects in US and Swedish existing multi-family buildings. They examine the costs of conservation measures and practices and the savings they generate and they also discuss the correlation between energy savings and initial pre-retrofit energy intensity, amount of investment, and choice of measures.

22715 (DOE/CE/27460—T5, pp 3.91-3.102) **Utility incentives program for the retrofit of commercial buildings.** Holt, E.A.; Moore, D. (Seattle City Light, WA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

Seattle City Light (SCL) has designed and is operating a pilot program offering financial incentives to its commercial customers. Seattle will offer two types of incentives: (1) a rebate covering 65% of the cost of pre-specified measures, and (2) an investment incentive that will cover the difference between the cost of audit-determined measures and the value of two-and-a-half years of savings. The rebates will be available only to small commercial cus-

tomers, while the investment incentives will be available to medium and large commercial customers. This program is compared to a three-year test program being conducted as one of six pilot programs sponsored by the Bonneville Power Administration (BPA) and the participating utilities.

22716 (DOE/CE/27460—T5, pp 3.103-3.105) **Energy conservation opportunities in commercial buildings - training and services for improved O/M.** Kolb, J.O. (Oak Ridge National Lab., TN). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The implementation of proper Operation/Management (O/M) procedures in commercial buildings has been recognized as not only cost-effective, but also as an essential prelude to additional and more costly conservation retrofit actions. The study presented discusses: 1) how to determine the scope and nature of O/M training and services for commercial building HVAC systems; 2) how to determine the the types of barriers that prevent or reduce the application of appropriate O/M procedures; 3) how to assess the potential for increased penetration of O/M services in the commercial building sector; and 4) how to propose efforts that integrate and leverage program elements of the Department of Energy Commercial Building Energy Retrofit research program with private sector initiatives.

22717 (DOE/CE/27460—T5, pp 3.106-3.114) **Research plan for commercial sector retrofits.** MacDonald, J.M. (Oak Ridge National Lab., TN). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149. Contract AC05-84OR21400.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

A plan for a Retrofit Research program at the Department of Energy covering commercial buildings was developed in 1985. The purpose of the plan was to define whether a Federal role was justified for retrofit research and, if so, what work should the program cover. Estimates developed as the program has progressed indicate that the technical potential for energy savings in commercial buildings from retrofit measures may be as high as 40% of total sector energy use. This implies a total potential savings of 5 Quads/yr or $30 Billion/yr. Technical potential means that simple payback periods are 10 years or less. However, savings for solar or other renewable energy retrofits are typically not included in the estimates. Achievable savings, which means that simple payback periods are 5 years or less, are estimated to be in the range of 20% of total use.

22718 (DOE/CE/27460—T5, pp 3.115-3.129) **Energy analysis of a retrofitted school building with a solar air heater.** Mahajan, S.; Soma, L.; Fumagalli, S.; Zabot, S.; Bhargava, A.K. (California State Univ., Sacramento, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

A low cost methodology is used to evaluate the thermal performance of a retrofitted school with a solar air heater. The main aim of the analysis is to determine with a reasonable accuracy the performance of the various subsystems and to make suggestions for improvements. Hourly data for weather variables, indoor temperatures, fuel consumption and heat delivered to the building (both from auxiliary and solar heater) are collected using an automatic Data Acquisition System (DAS).

22719 (DOE/CE/27460—T5, pp 3.130-3.132) **Overview of the Energy Edge project design upgrading efficiency in commercial construction practice.** Miller, K. (Bonneville Power Administration, Portland, OR). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The Bonneville Power Administration (Bonneville) is conducting a research project entitled the Energy Edge. Limited information is available on the economic value of designing and constructing commercial buildings which exceed code requirements. The Energy Edge project will examine costs and performance of highly efficient new commercial buildings. Due to design stage opportunities, new buildings are considered a first choice conservation resource. Commercial buildings which are not built efficiently today will be expensive to retrofit later. The information which results from the project will be used to examine commercial building codes. The commercial building sector is expected to grow faster than residential and industrial sectors in the Northwest. The Northwest has approximately 2000 commercial building starts annually. Many of these are small commercial buildings.

22720 (DOE/CE/27460—T5, pp 3.133-3.145) **Guldheden Project. Evaluation of extensive energy conservation measures in nine blocks of flats by measurements.** Nilson, A.; Walter, A. (Bengt Dahlgren AB, Sweden). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The Guldheden Project is a full-scale study of the effectiveness of different combinations of energy conservation measures in nine similar blocks of flats, situated in Gothenburg on the Swedish west coast. The implemented measures have been combined in different ways in the houses. Both basic measures, such as adjustment of the heating and ventilating systems etc, and more extensive measures, such as additional thermal insulation of external walls, triple glazing and exhaust air heat pumps, have been used.

22721 (DOE/CE/27460—T5, pp 3.146-3.159) **Energy use in the Enerplex office buildings: a progress report.** Norford, L.; Rabl, A.; Ryan, L.; Spadaro, J.; Socolow, R. (Princeton Univ., NJ). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

A full year of energy-use data is now available for two new, heavily instrumented office buildings which incorporate a variety of technologies designed to reduce energy consumption. They present monthly, disaggregated energy use in both buildings. One building, fully occupied, has exceeded its target energy budget by a factor of three, due to unanticipated and large electricity use by computers and a cafeteria; the need to remove the heat generated by this equipment and the inability to use the heat in winter; a failure to take advantage of the daylighting features designed in the building envelope; and limitations in the design and operation of the HVAC controls. Their study of the heat pumps and ventilation system in the other, partially occupied building has pinpointed fan and heat pump performance which is both somewhat less than predicted and difficult for the building superintendent to detect. They identify modifications the superintendent has made to the controls, in some cases reducing energy use and in others, particularly in overriding night setback, greatly increasing energy use. The superintendent's need for more information in adjusting the controls is highlighted.

22722 (DOE/CE/27460—T5, pp 3.160-3.172) **Exhaust air heat recovery.** Oestin, R.; Sandberg, O. (Univ. of Umea, Sweden). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

A number of exhaust air recovery units concerning energy conservation has been investigated in an apartment blocks retrofit project in the north of Sweden. The major aim has been to determine combinations of savings to be recommended in reaching the adopted goal stated by the government. The goal is to retrench the abroad oil dependence with 30% in a ten year period started in 1978.

22723 (DOE/CE/27460—T5, pp 3.173-3.175) **Energy edge buildings in Oregon.** Perry, J. (Oregon Dept. of Energy, Salem). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

Energy Edge is a project of the Bonneville Power Administration (BPA). It is being administered by four Sponsors. ODOE is the sponsor for Oregon outside the Portland area. Energy Edge is one of a number of actions mandated by the Northwest Power Planning Council in their regional energy plan. Thirty-four new commercial buildings will be built under the project within the BPA region - Oregon, Washington, Idaho and western Montana. These buildings will be selected during 1986. Construction and energy monitoring will occur over the next three years. These buildings will be designed to use 30% less energy than similar buildings conforming to the Model Conservation Standards (MCS). The MCS, also a product of the Council's plan, were recommended to utilities and local governments in the BPA Region. The MCS for new commercial buildings is a slightly modified version of the ASHRAE 90A - 1980 model energy code. The most significant difference is in the area of lighting. The MCS requires lower lighting power densities.

22724 (DOE/CE/27460—T5, pp 3.176-3.192) **Comparison of measured end-use consumption for 12 energy-efficient, new commercial buildings.** Piette, M.A. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

Assessment of the energy efficiency of commercial buildings is greatly enhanced by using energy consumption data that is more detailed than whole-building utility bills. They have compiled and analyzed measured end-use data for 12 new, energy-efficient commercial buildings from the BECA-CN data base. Data sources include federally funded energy-efficient building research programs and utility demonstration projects. Energy use data, broken down into lighting, cooling, heating, fans and pumps, and miscellaneous, are available for eight of the buildings. Data analysis consists of defining and comparing monthly and annual end-uses among the 12 buildings. When making comparisons among the buildings they consider differences in (1) miscellaneous equipment loads, (2) occupancy patterns, and (3) weather. Seasonal variations of end uses are discussed. Heating and cooling energy use appears to be correlated with average monthly outdoor temperature for most of the buildings. Lighting energy use tends to be higher in the winter than in the summer. They also compare the measured data to simulation data from ASHRAE Standard 90 research.

22725 (DOE/CE/27460—T5, pp 3.193-3.206) **Preparation of the third edition of the National Program Plan for the Thermal Performance of Building Envelope Systems & Materials.** Stamper, E. (New Jersey Institute of Technology, Newark). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The Research Coordinating Committees (RCC) of the Building Thermal Envelope Coordinating Council (BTECC) have appointed sub-committees charged with preparation of the chapters of the latest edition of the National Program Plan (NPP). This paper outlines the scope of the material to be presented in the NPP and presents a progress report on those chapters where the research needs are delineated. The chapters are being written on: (a) Thermal Performance of whole Buildings, (b) Moisture Control in Buildings, (c) Heat and Mass Transfer Elements, (d) Air Infiltration and Ventilation, (e) Roofing Design and Construction, (f) Fenestration, thermal performance and daylighting, (g) Materials. Research needs are enumerated for Whole Buildings, moisture control, heat and mass transfer.

22726 (DOE/CE/27460—T5, pp 3.207-3.217) **Cost containment through energy efficiency in Texas state-owned buildings.** Verdict, M.E.; Ponder, W.M. (Public Utility Commission of Texas, Austin). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The Energy Cost Containment Through Energy Efficiency in Texas State-owned buildings project was begun in the spring of 1984 as a part of a multipronged effort to reduce rising energy costs in State operations. Energy audits of 21 million square feet (22% of total conditioned space) were conducted by three energy engineering firms and Texas Engineering Extension Service personnel under contract to the Public Utility Commission of Texas. Retrofits totalling $15.6 million with annual savings of $9.2 million were identified (59% ROI). This paper will detail the objectives of the project, summarize audit results, and outline financing options for individual projects.

22727 (DOE/CE/27460—T5, pp 3.218-3.231) **Evaluation of integrated lighting system performance in a large daylighted office building.** Warren, M.; Benton, C.; Verderber, R.; Morse, O.; Selkowitz, S.; Jewell, J. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The use of daylight for ambient illumination can substantially reduce this energy usage if the electric lighting system is properly controlled in response to available daylight. This paper evaluates the monitored performance of an integrated lighting system in a recently completed 56,000-m^2 office structure in the San Francisco Bay Area. The paper presents a summary of daylighting and electric lighting performance as monitored in several zones of the building. Also discussed is the potential benefits of daylighting in the context of the overall building electrical energy use. Analysis of annual electricity use indicates that the ambient lighting electrical circuits represent 23% of the total building electricity use. Present operation of the building is consistent with dimming of the ambient lighting electrical circuits to 85% of full power. There are significant opportunities for dimming that are not used. Proper integration of the electric light dimming system is essential for the realization of projected savings in electric power consumption.

22728 (DOE/CE/27460—T5, pp 3.232-3.244) **Large commercial energy auditing program at Sacramento Municipal Utility District (SMUD).** Wiesner, R. (Sacramento Municipal Utility District, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

This report analyzes the results of the Large Commercial/Industrial (C/I) Energy Auditing Program at SMUD over the past five years. Three aspects of the program are discussed: (1) energy audit recommendations for the different types of facilities; (2) implemented measures for the different types of facilities; and (3) the period of time from the recommendation to the implementation. The program was conducted under California Energy Commission (CEC) guidelines from 1980 through 1985. In that period, SMUD staff conducted 111 energy audits for large C/I facilities with average peak demands over 500 kw. This group of customers uses over 450 million kilowatt hours of electricity annually.

22729 (DOE/CE/27460—T5, pp 3.245-3.247) **Industrial energy retrofits - an underutilized resource.** Willman, A.J. (ACEC Research & Management Foundation, Washington, DC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The impressive reduction in energy use over the past 10 years in the industrial sector is well known to have exceeded the energy reduction in the commercial and residential building sector. One of the ways this has been accomplished is the retrofit of existing manufacturing buildings and processes. To increase the knowledge base of the many innovative techniques which have been applied, the American Consulting Engineers Council Research and Management Foundation (ACEC/RMF) has conducted a wide review and compilation of state of the art industrial retrofit technologies. This summary will review the data collection methods employed and the ways in which the results of this major effort have been compiled and disseminated.

22730 (DOE/CE/27460—T5, pp 3.248-3.250) **Measured performance of cool storage in buildings: summary of initial analysis.** Wyatt, E.; de la Moriniere, O. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005149.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 3, proceedings from the panel on large building technologies.

The tracking of thermal storage systems in commercial buildings is part of a larger effort at LBL to assess measured data on the energy performance and economic cost-effectiveness of all types of buildings. This Buildings Energy-use Complication and Analysis project has resulted in a large database (BECA), organized by sector. BECA-LM is their compilation of load management measures, including cool storage systems. The study began with the concept that the quality of analysis increases with the level of data available for each building. For a thorough study, the authors stressed the importance of submetered data on the cooling system itself - electricity, demand and flow meters. In addition to energy use and peak demand (with descriptive and operational conditions), compressor efficiency and hourly load profiles on the peak cooling day are also desirable pieces of information to have. Immediately apparent was the lack of monitoring of this nature in most buildings - partly due to expense, and partly due to the lack of interest in knowing more about a building's operation. They started by looking at whole building data, which are much more readily available. The idea was that building energy consumption would reflect the operation of the cooling system. From the current level of analysis, three major points can be drawn: (1) although readily available, whole building data are insufficient to adequately study the operation of a particular system within a building; (2) a thoughtful combination of indicators is necessary to evaluate actual thermal storage performance; (3) several years of data should be examined, as systems tend to significantly improve over the first few years of operation.

22731 (DOE/CE/27460—T14, pp 5.5-5.19) **Participation of the elderly in utility-sponsored residential conservation programs.** Berry, L.G.; Brown, M.A. (Oak Ridge National Lab., TN). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151. Contract AC05-84OR21400.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Although greater-than-average opportunities for residential energy-efficiency improvements exist among the elderly, most utility-operated conservation programs are not successful in reaching this subgroup. This paper reviews research on elderly participation in utility programs. It contains a literature review, descriptions of program participation levels among the elderly, and a discussion of discrete choice model results which show that the association between age and nonparticipation persists even after the effects of other predictors such as income, education, dwelling age and need for retrofit are removed.

22732 (DOE/CE/27460—T14, pp 5.20-5.36) **Achieving commercial/industrial energy efficiency in a market environment.** Clinton, J.M. (Barakat, Howard and Chamberlin, Inc., Berkeley, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

This paper outlines the importance of the marketplace in which individual, commercial, and industrial energy users make decisions about energy management measures. These decisions are carried out with the support of an infrastructure composed of energy service providers and product manufacturers. The effectiveness with which this market operates in satisfying the needs of both energy users and profit-seeking energy service businesses determines the ultimate level of energy management activity.

22733 (DOE/CE/27460—T14, pp 5.37-5.49) **Understanding the market for conservation technologies in the commercial sector.** Dinan, T.M. (Oak Ridge National Lab., TN). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

The purpose of this paper is to further the understanding of the decision process associated with conservation retrofit investments in the commercial sector. It includes a discussion on: the stages involved in a decision to undertake conservation retrofit activities; the participants that might be involved in such decisions; the decision criteria utilized by different types of organizations; barriers to implementing conservation; and the impact that the attributes of conservation investments might have on the decision outcome.

22734 (DOE/CE/27460—T14, pp 5.50-5.59) **Community partnerships for energy conservation.** Dreyfuss, P.M. (Metropolitan Energy Information Center, Kansas City, MO). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Community based energy conservation projects are the new imperative for the 1980's due to the cutbacks in funding for energy conservation at the federal level. Establishment of public/private partnerships at the local level can provide an effective means to provide weatherization and energy conservation services to low income clients in light of declining public dollars. This paper was prepared for the 1986 Summer Study on an effective program that was developed in Kansas City, Missouri using private contributions and volunteers working in cooperation with community based not-for-profit organizations.

22735 (DOE/CE/27460—T14, pp 5.60-5.61) **Energy auditor & retrofitter: practical information for practitioners.** duPont, P.T.; McFarland, L.R. (Energy Auditor & Retrofitter, Inc., Berkeley, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Energy Auditor & Retrofitter, Inc. is a non-profit organization that disseminates practical information on residential energy conservation. Its main product is a bimonthly magazine, Energy Auditor & Retrofitter (EA & R), which was first published in September, 1984. For the past two years the staff has been developing EA & R into a magazine that will serve the needs of workers in the residential conservation industry. This task has involved three major activities: (1) identifying the potential market of readers; (2) transferring information from a variety of sources into the magazine format; and (3) serving as an open forum for those in the industry.

22736 (DOE/CE/27460—T14, pp 5.62-5.74) **Residential segmentation for marketing utility programs: general or specific?.** Feldman, S.; Finkbeiner, C.T.; Berrigan, J.A.; Lewis, L. (National Analysts, Philadelphia, PA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

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To assist electric utility managers in the design, implementation and marketing of demand-side programs through improved understanding of customers, the Electric Power Research Institute (EPRI) is sponsoring development of a database on customer preferences and behavior. Descriptions of convenient and useful residential market segments will be included in that database. A battery of 141 needs/benefits statements was generated from the results and analysis of qualitative discussions among residential customers in eight focus groups and twelve family depth interviews. These statements were presented in an agree-disagree format to 161 other respondents via computerized interviews in four locations across the country.

22737 (DOE/CE/27460—T14, pp 5.75-5.92) **Marketing energy efficiency in North Carolina public housing: lessons learned from field experience.** Gee, P.S.; Aldridge, K.; Sorrell, Y. (North Carolina Alternative Energy Corp., Research Triangle Park). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

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The North Carolina Alternative Energy Corporation (AEC) has over two years of experience in developing a comprehensive program to improve energy efficiency in public housing, especially the smaller all-electric authorities. Elements of that program include: (1) creating incentives to motivate public housing administrators to pursue energy efficiency; (2) comparing alternative strategies for achieving energy efficiency in multi-family housing; (3) demonstrating creative multi-participant financing options to fund energy improvements; (4) developing effective ways for smaller PHAs to implement energy improvements; and (5) analyzing results to provide PHAs with feedback on energy efficiency efforts for multi-family housing.

22738 (DOE/CE/27460—T14, pp 5.93-5.100) **Winning community support for demand-side programs through pilot programs.** Hopkins, M.E.F. (Consumer Energy Council of America, Washington, DC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Demand-side management programs require the cooperation of customers to be successful. This paper presents a case study of pilot programs developed by an energy consumer group, a utility company and a community group to build customer support for utility demand-side management programs. Community group collaboration is shown to enhance program effectiveness by involving customers in initial project development. Conservation programs discussed include a solar bank lending program, a refrigerator rebate program and a residential energy audit program.

22739 (DOE/CE/27460—T14, pp 5.101-5.113) **New directions for conservation programs.** Kreitler, V.; Kirchen, S. (Synergic Resources Corp., Bala Cynwyd, PA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Thirteen residential conservation programs were selected to serve as case studies in an evaluation of alternatives to the RCS (Residential Conservation Service) program. The findings from that study provided the basis for the discussion in this conference paper. This paper reviews selected program planning approaches currently in use, comparing their benefits and suggesting that there is a need for greater formalization of the planning process. In addition, the need for better understanding of customer acceptance factors is discussed. Some new efforts in the areas of program planning and market research are identified. The discussion concludes with a recommendation that the government and trade associations need to address further program planning and evaluations issues while utilities individually need to adopt a more proactive stance toward their programs and the conservation marketplace.

22740 (DOE/CE/27460—T14, pp 5.114-5.125) **Technical and promotional interface in marketing energy efficiency: Springfield sells heat pumps.** Kunka, J. (American Public Power Association, Washington, DC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

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Two components are vital to a successful energy efficiency program. First, the technologies must be sound and carefully applied. Secondly, the program must be sold. Often, it seems that programs fail in one area, while being strong in the other, or that the technical and promotional components are somehow mismatched. The experience of Springfield City Water, Light and Power (CWLP), a municipal utility serving the Illinois state capital, demonstrates how technical and promotional components can be developed to reinforce one another to create a remarkable success. CWLP reported a 400% increase in the number of heat pump rebates provided during the first year after the existing cooling and heat pump efficiency rebate program was expanded to provide this concentrated heat pump marketing effort. The success is attributed to the interface between technical and promotional approaches within all program components.

22741 (DOE/CE/27460—T14, pp 5.126-5.128) **Preliminary evaluation findings WPL's great refrigerator rebate program.** McKellar, B.J. (Wisconsin Power and Light, Madison). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

This summary describes the preliminary findings of an ongoing evaluation of Wisconsin Power and Light's (WPL's) Great Refrigerator Rebate Program, a residential rebate pilot program that was in effect from May-December 1985. The pilot program was designed to motivate WPL's retail residential electric customers in three of WPL's 14 service districts to purchase energy efficient refrigerators. During the pilot program, 1950 WPL customers purchased energy efficient refrigerators and received a rebate from WPL. There were three rebate levels (high, higher and highest), and the amount of the rebate for each efficiency category varied across the three pilot districts - Janesville, Sheboygan and Tomah. In the Janesville and Sheboygan districts the three rebate levels increased with refrigerator efficiency levels ($30, $40, $50 and $50, $75, $100, respectively). In the Tomah district the rebate level was $50 for each efficiency level.

22742 (DOE/CE/27460—T14, pp 5.129-5.141) **Marketing energy investments to parties of commercial short-term leases: barriers and opportunities.** McRae, M.R.; George, S.S.; da Silva, J. (Xenergy, Inc., San Francisco, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

This paper discusses the opportunities that utilities have to successfully market conservation investments to commercial landlords and tenants who are party to short-term leases. Program characteristics that are responsive to the needs of customers in this sector are identified and marketing strategies that address customer concerns and allay customer fears are described. The conclusions are based upon an understanding of the factors that make the short-term lease sector unique, the motivations of tenants and landlords in the sector, and the factors that each group describes as barriers to their investment.

22743 (DOE/CE/27460—T14, pp 5.142-5.157) **Evaluating a community based private/public partnership in residential energy conservation.** Morgan, S.J. (Technical Development Corp., Boston, MA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

Twelve public and private organizations serving Portland, Maine collaborated to establish a comprehensive, one-stop residential conservation program model during the fall and winter of 1984-5. Portland's Weatherize Portland Planning Task Force launched a demonstration program to test the model in two neighborhoods from February to May 1985. In September 1985 the US Department of Energy (DOE) funded an evaluation of the planning process and the demonstration program. The Technical Development Corporation, with two subcontractors - Energy Systems Research Group and Einstein Consultants - have undertaken this evaluation. The program is described.

22744 (DOE/CE/27460—T14, pp 5.158-5.159) **Low-income community weatherization.** Newman, J.S. (Pacific Gas and Electric Co., San Francisco, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

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Community weatherization is wholesale door-to-door weatherization. Every unweatherized home in a selected community is weatherized to meet the Big Six standards. In addition, minor home repairs not exceeding $200 are provided as part of the service. Every residential utility customer living full time in the selected community is eligible to receive weatherization and home repair services. There is no cost to the resident for the service. Communities are selected on the basis of average community-wide income levels. To qualify, a community must have an average income level equal or lower than the qualifying level for the company's regular low-income weatherization program. The regular program is offered to qualified residential customers throughout the service territory. The basic qualifying income level is 150% of the Federal poverty level. Independent weatherization contractors perform the weatherization and minor home repair services. The contractors are selected by the local utility office through competitive bidding under standard bid procedures. Every home weatherized under the low-income community weatherization program is inspected by a utility company inspector.

22745 (DOE/CE/27460—T14, pp 5.160-5.165) **Energy studies program at Stockton State College.** Stiles, L.F. (Stockton State College, Pomona, NJ). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

A unique undergraduate program for arts, science and business students focusing on energy studies and the use of high technology equipment has been underway at Stockton State College since 1983. Energy topics courses have been offered since 1975, with an Energy Studies Certificate Program being established in 1983. Through a judicious choice of elective courses, a science or planning major can complete both the requirements of his/her major and also those of the Energy Certificate. In the last two years, twelve students have received this certificate. The certificate program only accounts for a small fraction of student enrollments in courses entirely dedicated to an energy topic. In addition, the introductory physics courses directly address energy related applications. Energy studies at Stockton includes the Energy Studies Certificate Program as a focus of many energy-related courses.

22746 (DOE/CE/27460—T14, pp 5.166-5.177) **Marketing the Austin Energy Star program using private sector techniques to market a public sector program.** Vories, R. (Financial Energy Management, Inc., Denver, CO). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005151.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 5, proceedings from the panel on marketing.

The Austin Energy Star Program is a rating system for new homes sponsored by the Resource Management Department of the City of Austin, Texas. The purpose of the program is to encourage the construction of more energy-efficient homes throughout the service territory of Austin's municipal electric utility. The purpose of this paper is to outline the marketing approach taken to simplify this program to make it easily understandable to potential home buyers, builders, Realtors and lenders. The paper will be divided into three parts: marketing theory and the role it played in the development of the marketing program, use of building industry techniques and professionals as the direct consumer contact for the program, and discussion of the specific communications pieces and approaches used to reach out to these audiences. Included in the presentation will be a 7 minute slide/tape show which promotes the program to home buyers while they are in model homes or Realtors' offices.

22747 (DOE/CE/27460—T15, pp 4.5-4.16) **Development of a European market for third party finance.** Brown, I. (Association for the Conservation of Energy, London, England). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

In 1985 research was undertaken in the twelve countries of the EEC into the potential market for third party finance (as defined below). This research was instigated from the starting observation that the level of investment in energy efficiency equipment installed through the mechanism of performance contracting is considerably greater in North America than in Europe. This observation begged several questions, which the research set out, at least in part, to answer. Is there a market for third party finance in Europe and how big is that market? Why has the concept not developed as fast (or indeed hardly at all) in Europe as in North America? What are the barriers preventing the growth of third party finance? What actions can be taken (if any) to overcome these barriers? Research results presented in this paper are the summary of well over one hundred personal interviews with relevant organizations and individuals throughout the twelve countries of the EEC. These interviews all took place between March and October 1985.

22748 (DOE/CE/27460—T15, pp 4.17-4.28) **Utility marketing of state conservation loans.** Codina, R. (Sacramento Municipal Utility District, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

This paper details the results of a collaborative effort by the Sacramento Municipal Utility District (SMUD) and the California Energy Commission (CEC) to market state conservation loans. The program provided loans at 8.89% interest rate to schools, local governments, hospitals and special districts for energy conservation projects. The joint project marked a departure in the traditional relationship between the CEC and SMUD whose bonds where largely regulatory based on the state agency's review of the utility's conservation plans and programs. By sponsoring the loan program, SMUD, an all-electric utility, sought to reduce electric use particularly during its summer peak period. For its part, the CEC hoped the arrangement would achieve greater participation levels and reduce its administrative time.

22749 (DOE/CE/27460—T15, pp 4.29-4.38) **Innovative approaches to facilitate energy efficiency improvements in New York state's public sector.** DeWitt, L.B.; Wolcott, D.R. (New York State Energy Research and Development Authority, Albany, NY). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

A fundamental problem facing the public sector today is that both traditional and non-traditional methods of reducing energy consumption in public buildings have made little progress. Because of a lack of financing, poor managerial expertise, and an aversion to risk, public institutions must examine alternatives to the traditional capital budgeting process and bond financing. In New York State, three different options are currently under active consideration in this regard: (1) Energy Performance Contracting: providing ad-hoc technical assistance to encourage private investment in public buildings through normal marketplace activity of energy service companies; (2) State Facilities Conservation Fund: establishing a special revolving investment program that supplies public resources for improvements in public buildings, thus keeping all the savings in the public sector; and (3) Corporation for Energy Financing: establishing a public institution to steer private financing and managerial resources to public buildings by assisting in making deals happen that might not occur otherwise. This paper traces the advantages and disadvantages of each of these three options and concludes with some rules-of-thumb that might guide a rational approach to mixing and matching the different approaches.

22750 (DOE/CE/27460—T15, pp 4.39-4.51) **Achieving energy efficiency in government operations: the local energy officer project.** Emmett, M.; Gee, P.S. (North Carolina Alternative Energy Corp., Research Triangle Park). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

For many local governments in North Carolina, energy costs represent the second largest operating expense, exceeded only by personnel costs. Almost $650,000 in savings were realized in two years by seventeen governments participating in the demonstration phase of the Local Energy Officer (LEO) project. Costs were controlled by trained, in-house personnel who monitored consumption and improved energy efficiency. Each officer saved an average of $2 for every $1 expended for their salary and benefits. A salary guarantee offered by the North Carolina Alternative Energy Corporation (AEC) presents a unique marketing approach to an institutional energy management program. Each local government agrees to hire or internally reassign an energy officer and to fund economic capital investments. In exchange, the AEC trains the officers, provides technical assistance, and guarantees that in two years the government will save in energy costs what they pay the energy officer in salary and benefits. If not, the AEC will reimburse the difference. After the first two years of operation, the AEC will pay less than 3% of the guarantees. A revised LEO model is currently being applied with thirteen additional governments. The experiences derived from the two demonstrations will be used to promote the use of an in-house energy manager to other local governments across the state. This paper focuses on the prime savings opportunities in local governments, the methods for overcoming institutional barriers, the role of the salary guarantee, the methods for calculating savings, and the design of a self-sustaining program.

22751 (DOE/CE/27460—T15, pp 4.52-4.64) **Financing energy efficiency in public housing: innovative regulatory opportunities.** Ferrey, S. (Suffolk Univ., Boston, MA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

This paper reviews the salient points of the recent regulatory change and introduces the reader to the complicated environment of public housing energy regulation. It reviews the energy savings potential in public housing buildings and appliances, and charts a six-phase implementation of the strategy, illustrating impacts on energy efficiency, cash flow and funding allocations from HUD. It concludes that by creative use of the author's energy efficiency strategy, non-utility cash flow for the housing authority and its tenants can be increased from 14-25% in the first year. This paper identifies a special regulatory roadmap to reach a major section of the rental market heretofore screened off from effective efficiency investments. It provides a vehicle to address these needs paired with creative financing mechanisms to implement the strategy at the local level.

22752 (DOE/CE/27460—T15, pp 4.65-4.75) **New initiatives in financing multifamily energy conservation: recent developments in Chicago.** Freedberg, M.; Schumm, D. (Center for Neighborhood Technology, Chicago, IL). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

This paper describes a new program aimed at multifamily energy conservation in Chicago. The $15 million Chicago Energy

Savers Fund is a unique public-private partnership aimed at preserving affordable housing in Chicago. Financed jointly by the City of Chicago and the local natural gas utility, People's Gas Light and Coke, the program provides low-interest financing (6%-8%) and a comprehensive package of technical services for energy conservation improvements in single-family homes and apartment buildings. Targeted primarily (but not exclusively) at the city's shrinking rental housing stock, the program is administered by an unusual consortium of local, non-profit community-based agencies in partnership with city government and the local utility. Approximately 175 buildings have been audited (3758 units), and some $2 million committed in multifamily loans, making the program one of the largest of its kind in the country. The paper provides an overview of (1) regulatory issues at the Commerce Commission (2) technical issues, including the development of a multifamily energy audit for the program, and training of community-based energy auditors; (3) marketing and implementation issues; (4) loan underwriting and financing issues; and (5) results after 18 months. Energy audits project average savings of 28% per building, at an average retrofit cost of $1242/unit. Measured savings range from 26% to 42%, exceeding projected savings by an average of 10%.

22753 (DOE/CE/27460—T15, pp 4.76-4.78) **Revenue bonds: a new approach for financing conservation in California state facilities.** Garland, M.M. (Babcock & Brown, Inc., Sacramento, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

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An outline of the California bond program aimed at financing energy conservation measures in state buildings is presented. Energy projects at California state facilities are listed, along with the bond program highlights and the project selection process.

22754 (DOE/CE/27460—T15, pp 4.79-4.100) **Energy performance contracting for building operation and retrofit: lessons from the French experience.** Harris, J.P. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150. Contract AC03-76SF00098.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

Over the past four decades, France has evolved a complex system of performance-based contracting for the operation of heating systems in buildings and larger industrial and district heat facilities. Some US observers consider the French heating service contracts as a model for the emerging energy services industry in the US. The assumption is made that contracting to pay an agreed-upon amount for delivered heat can sidestep the traditional reluctance (or inability of building owners to invest in energy-saving retrofits - while also providing an effective incentive for long-term energy management. This paper takes a closer look at the actual experience with heating service contractors (exploitants de chauffage) in France, and some possible lessons for the US. Of course, direct comparisons between France and the US should be made with caution, considering the differences in institutional structures, building ownership patterns, and levels of building energy use and cost. Nonetheless, US policymakers should note the paper's conclusion that French performance contracting has yet to demonstrate, in practice, the advantages claimed for it in theory.

22755 (DOE/CE/27460—T15, pp 4.101-4.103) **Energy management service - shared savings financing is it worth all the hassle?.** Kerwin, J.J.; Thompson, S.E. (Energy Resource Center, St. Paul, MN). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

For the past three years the Energy Resource Center has operated a Shared Savings - Energy Management Service Program for financing energy improvements in residential rental property. The program was designed to overcome the traditional barriers to conservation investment in rental property: financial, technical, and tenant/landlord incentives. Now that their investment portfolio has operated through at least one complete heating season, they are prepared to evaluate their success and comment on the complications and additional costs incurred to overcome the barriers.

22756 (DOE/CE/27460—T15, pp 4.104-4.107) **State programs to promote performance contracting of energy projects.** Michaelson, M.L. (Lane and Edson, P.C., Washington, DC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

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In recent years, performance contracting programs for energy efficiency, cogeneration and alternative energy projects have been undertaken by governments throughout the country, with states appearing to take a leading role in demonstration programs. Michigan, North Carolina, Massachusetts, New York, Florida, Mississippi, California, Washington, Indiana, Connecticut, New Jersey and Delaware have each sponsored demonstrations of performance contracting in public and/or private buildings. The availability of funds from settlements of oil-overcharge cases is certain to increase state activity in this area. As states continue their performance contracting activities, it is important to reflect on the lessons of prior experiences and consider ways to improve future efforts. This paper outlines a few of the key lessons learned from existing programs and suggests a few strategies for future efforts.

22757 (DOE/CE/27460—T15, pp 4.108-4.118) **Energy efficient mortgage: new lending policies to boost bank acceptance.** Miller, R. (Alliance to Save Energy, Washington, DC). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

This paper describes the preliminary findings of a demonstration project the Alliance to Save Energy is conducting in Hartford, Connecticut to promote adoption of this mortgage financing option. Conn Save Inc. and the Alliance have investigated barriers which inhibit lenders from offering this option and conducted focus group testing with Connecticut home buyers to determine their interest in using this financing arrangement. Results of the focus group test and summaries of discussions with lenders, realtors and appraisers are presented. This loan program achieved limited success when first introduced through a pilot project in 1983. The original lending policies governing the loan option have been restructured to address lenders' concerns and are being tested in this demonstration project. This paper describes these new policies.

22758 (DOE/CE/27460—T15, pp 4.119-4.131) **Financial impacts of energy conservation investment in public housing.** Mills, E.; Ritschard, R.L.; Goldman, C.A. (Lawrence Berkeley Lab., CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

In recent years, the Department of Housing and Urban Development (HUD) has strongly urged local public housing authorities (PHAs) to improve the energy efficiency of their building stock in an effort to reduce upward-spiraling energy costs. Local public housing authorities can fund conservation measures with: (1) HUD Comprehensive Improvement Assistance Program (CIAP) funds, (2) general operating subsidies, (3) utility-sponsored conservation financing programs, and (4) third-party investments. In this study, they examine the relative financial impact on HUD and PHAs of

these four funding strategies, based on case studies of actual retrofit efforts by two local housing authorities: San Francisco, California and Trenton, New Jersey. The selected retrofits all show significant energy savings. This is not, however, reflected in the financial benefits to each party because current provisions of the Performance Funding System (PFS) for public housing energy subsidies require that costs and savings associated with energy conservation retrofits be shared between HUD and the local housing authorities, regardless of the financing mechanism used. Their results indicate that the provisions of the PFS often result in a net loss to the local housing authority, while HUD enjoys substantial benefits. This occurs even for conservation measures with payback periods less than three years; hence the present policy reduces the incentive for PHAs to invest in conservation projects that are very cost effective from the societal perspective.

22759 (DOE/CE/27460—T15, pp 4.132-4.144) **Customer value of service, shortage costs, and demand-side management program design.** Rosput, P.G.; Crane, C.M. (Pacific Gas and Electric Co., San Francisco, CA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

In the last decade, Demand-Side Management (DSM) has offered utilities a nontraditional planning option focused on deliberately changing the load shape to improve electricity system efficiency. Traditionally, DSM programs such as conservation, load management, and time-of-use (TOU), have been designed based on marginal costs derived from utility resource plans. Customers volunteered for these programs based on individual determination of the worth of electric service during particular hours and seasons. However, the programs were designed to influence customer use of energy according to utility needs for load relief and not according to customer preferences. An emerging approach takes a somewhat different path. Through the use of a customer survey which allows customers to reveal their value-of-service (VOS) for a variety of service reliability options, DSM programs may be designed to fit particular needs and desires of individual customers. In 1983 Pacific Gas and Electric Company initiated its Value-of-Service study to gather outage cost estimates of the four major customer classes (residential, commercial, industrial, and agricultural) with the intent to use this information in value-based planning. Those outage cost estimates are shown and the study methodology is discussed.

22760 (DOE/CE/27460—T15, pp 4.145-4.147) **Purchase of Energy Savings Pilot Program's role within BPA's commercial buildings program strategy.** Schick, H.; Broillet, R. (Bonneville Power Administration, Portland, OR). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

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The Bonneville Power Administration (BPA) is conducting a number of activities to encourage energy efficiency in commercial buildings. The activities combine to test design options relating to the elements needed for a successful conservation program. One of these activities is the Purchase of Energy Savings (PES) effort. The PES effort is designed to test private entrepreneurs as deliverers of commercial sector energy savings. These sponsors are responsible for marketing the program to attract participation, auditing commercial buildings to identify potential energy savings, and coordinating the financing, installation and maintenance of the energy conservation measures on behalf of the building owners. In return, sponsors receive incentive payments from BPA over a number of years based on either estimated or measured energy savings from the building retrofits. To evaluate the ability of private entrepreneurs as deliverers of commercial sector energy savings their performance in all areas must be considered. Through the field test and pilot program, BPA is working with a wide variety of potential sponsors, including energy service companies (ESCos), architectural and engineering firms (A & Es), equipment manufacturers, utilities, and building owners. Interviews with sponsors and building owners are used to determine in which areas sponsors tend to excel and in which areas difficulties are encountered. Results to date indicate that local ESCos and A & Es are most capable of completing jobs. The success of these entities seems to stem from their previous experience with one or more of the areas of major responsibility under the program.

22761 (DOE/CE/27460—T15, pp 4.148-4.161) **Leveraging private sector investment for multi-family energy conservation: new approaches to corporate/community financing.** Smith, A.E. (Community Energy Development Corp., Philadelphia, PA). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

Community Energy Development Corporation (CEDC), a non-profit organization, has developed a portfolio of loan guarantees, below market rate loans, shared savings financing, and leveraged certificates of deposit to provide attractive financing alternatives to rental property owners. These financing mechanisms have enhanced CEDC's ability to overcome traditional barriers to owner-financed energy conservation improvements. The paper reviews financing mechanisms employed throughout the country for energy conservation improvements to multi-family buildings, highlights their relative benefits and constraints for this type of market, and provides detailed guidelines on how to develop and market creative financing programs. Emphasis is placed on how to market the benefits of multi-family energy conservation to all participants, as well as to show how these financing mechanisms can help support the costs of marketing and delivering energy conservation services. These financing mechanisms offer a viable alternative to the dwindling federal resources available to address the energy efficiency needs of multi-family buildings housing low income tenants.

22762 (DOE/CE/27460—T15, pp 4.162-4.163) **State of Iowa facilities improvement corporation.** Stanley, R. (Iowa Dept. of Natural Resources, Des Moines). Aug 1986. American Council for an Energy-Efficient Economy, 1001 Connecticut Ave., NW, Suite 535, Washington, DC 20036. File Number TI87005150.

In ACEEE (American Council for an Energy-Efficient Economy) 1986 summer study on energy efficiency in buildings: Volume 4, proceedings from the panel in incentives.

The State of Iowa currently spends about $40 million on energy for state-owned buildings. Most of this energy is obtained from other states and foreign countries. To reduce both the state's energy bill and the proportion of energy dollars spent outside the state, the Iowa Energy Policy Council has designed a program to improve the energy efficiency of state-owned buildings. While some savings can be achieved by reducing energy waste and making low-cost improvements, most of the remaining opportunities to save energy require substantial capital outlays. The Energy Policy Council estimates that an investment of $40 million in permanent conservation improvements would reduce energy consumption by 20 to 25%, thereby saving about $10 million dollars per year at current energy prices. The principal barrier to a conservation investment program of this magnitude is obtaining the necessary capital. For the state to pay for the needed energy improvements from its annual operating budget, either a tax increase or substantial shifting of funds from other programs would be required. Issuing general obligation bonds is another possible approach, but one that, historically, Iowans have been reluctant to employ.

22763 (DOE/CE/63502—T2) **Vermont Energy Investment Corporation and Energy Technicians, Inc. business plans: Final report to the Champlain Valley Office of Economic Opportunity on Department of Energy Energy-Related Business Development Grant.** Sachs, B.; Hamilton, L.B.; Binns, D.B.A. (Memphremagog Group, Newport, VT (USA)). 23 Mar 1987. Contract FG01-86CE63502. 129p. NTIS MF A01; 2; GPO Dep. File Number DE87007002.

Energy Technicians, Inc. (ET) is a for-profit corporation established by Champlain Valley Office of Economic Opportunity

(CVOEO) to provide a variety of energy efficiency contracting services in the public and private marketplace. ET has been created to provide new opportunities for CVOEO to stabilize and expand its weatherization services. Market research conducted by CVOEO prior to the establishment of ET determined that there is a significant need for high quality weatherization and energy efficiency services in the low and moderate income community. The Vermont Energy Investment Corporation (VEIC) was formed as a non-profit corporation to stimulate the demand for energy efficiency and address the barriers to its implementation. VEIC's services include financing, marketing, technical analysis, construction management and inspection.

22764 **(DOE/NBM—7006834) Innovative, cost-effective use of capital resources to induce conservation investment by commercial businesses.** (Eugene, City of, OR (USA); ECO Northwest, Portland, OR (USA)). 1987. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87006834.

For the last several years, the local housing authority has operated a successful low-interest loan program for the small business sector. One of the reasons for its success is that the program's managers have worked hard to get the ideas of local people incorporated into the program. In effect, the businessperson has been treated as a client for a specific product - the loan. This effort demanded much patience on the part of the housing authority staff and has been an example of how governmental outreach programs can actually work and be effective.

22765 **(EPRI-EM—5094) Luminaire retrofit performance: Commercial building lighting systems: Final report.** DiLaura, D.L.; Kambich, D.G. (Lighting Technologies, Boulder, CO (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. 131p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920289.

An investigation was performed to test retrofit methods of increasing luminous efficiency of existing four-lamp fluorescent lighting systems. Two methods were tested: installing custom-designed silver-coated reflectors, and lining the interior of the lighting equipment with silver- or aluminum-coated reflective film. The average luminous efficiency rose from 56 to 80% when either of these methods was used. This increased efficiency permitted two of the four fluorescent lamps to be removed, which reduced the electrical load of the lighting system by 53% while reducing the lumen output by only 28%.

22766 **(LBL—22688) Energy savings in retrofitted multi-family buildings: New results from the BECA-B [Buildings Energy Use Compilation and Analysis] project.** Goldman, C.A.; Greely, K.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 29p. (CONF-860818—17). NTIS, PC A03. File Number DE87006936.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Measured data were compiled and analyzed on 141 retrofit projects in US and Swedish existing multi-family buildings. The costs of conservation measures and practices and the savings they generate were examined. The correlation between energy savings and initial pre-retrofit energy intensity, amount of investment, and choice of measures was discussed. Various HVAC system retrofits (heating controls, equipment measures, and altered operation and maintenance practices) are the most popular conservation strategies in our sample of buildings. Most buildings in the data base are small to medium size multi-family buildings; 60% are between 10 and 50 units; only 10% are more than 100 units. Retrofit costs are less than $250/unit in 40% of the buildings, which suggests that many building owners confined their retrofit efforts to fairly low-cost measures. On average, initial retrofit costs are a lower fraction of annual energy expenditures in our sample of US buildings than in our Swedish buildings (0.6 versus 2.1). Median annual energy savings are 11 MBtu per dwelling unit, or 16% of pre-retrofit energy use. Energy savings are between 10 and 30% in 60% of the retrofit projects. Categorizing each retrofit project by strategy helped explain much of the variation in the amount invested; however, energy savings still varied widely among similar groups. Preliminary results for buildings in the data base suggest that some envelope measures (e.g., "shell" package and window measures) have longer payback periods (12 and 16 years, respectively) than many of the heating system retrofit strategies (1-3 years). Individual conservation measures that are particularly effective in specific building and heating system types (e.g., outdoor resets for cold-climate buildings with hydronic boilers) are reported.

22767 **(NP—7900551) Groundwater heat pump performance improvement with pre-coolers and pump modification: Final report for the 1985-86 SOMED [School of Mines and Energy Development] project year.** Kavanaugh, S. (Alabama Univ., University (USA). School of Mines and Energy Development). 30 Sep 1986. 57p. School of Mines & Energy Development, Box 6282, Univ. of Alabama, Tuscaloosa, AL 35486. File Number TI87900551.

Improved performance of groundwater heat pumps can be realized with a more effective and efficient utilization of the thermal properties of shallow groundwater. These systems circulate water from aquifers through water source heat pumps to achieved high efficiencies and capacities. This project concludes that a 10 to 15 percent cooling performance improvement can be realized by pre-cooling the room air with the 55° to 67°F groundwater available in large portions of the Southeast. Proper design of these pre-coolers eliminates unnecessary auxiliary energy requirements. The efficiency of the overall system can be further improved with modifications to current methods of water circulation system design. Pressure requirements are minimized by maintaining a low unit inlet pressure (8 psig maximum), removing unnecessary loop restrictions and injection below the water table. Standard submersible water pumps exceed the resulting required size for residential groundwater heat pumps. Simple modifications can be made by the manufacturer to correct this problem. The result is an overall 15 to 40 percent performance improvement over high efficiency air source heat pumps with a simple payback of between 0 to 10 years in most cases.

22768 **(PB—87-137832/XAB) HVAC (heating, venting, and air conditioning) system fault diagnosis and energy optimization using state-space methods and modern control theory. Final report.** Usoro, P.B.; Negahdaripour, S.; Schick, I.C.; Nadira, R.; Larimore, W.E. (Scientific Systems, Inc., Cambridge, MA (USA)). Aug 1984. 144p. NTIS, PC A07/MF A01.

The report addresses the fault detection, diagnosis, and control of Heating, Venting, and Air Conditioning (HVAC) systems. The problems associated with the effective operation of HVAC systems are identified, and a hierarchical framework for the operation of the system is formulated. A modern multivariable control approach, Model Algorithmic Control (MAC), was found to be a suitable approach for integrating the different hierarchies in the operation of the system. A methodology for detecting and diagnosing faults in the system using a nonlinear mathematical model of the system plus extended Kalman filtering was developed. This technique was implemented in a computer program and successfully used to detect planted faults in the air-handling unit of the HVAC system.

22769 **Science and society test X: Energy conservation.** Hafemeister, D. (Center for Building Sciences, Lawrence Berkeley Laboratory, Berkeley, California 94720; Physics Department, California Polytechnic University, San Luis Obispo, California 93407). *American Journal of Physics;* **55**: No. 4, 307-315(Apr 1987).

United States energy consumption has remained essentially constant at about 80 exajoules/year (75 quads/year) since the oil embargo of 1973—1974, while the GNP in constant dollars has increased by about 30%. This article will discuss the physics behind some of these improvements in end-use efficiency in such areas as: (I) buildings (scaling laws, "free-heat," superinsulated houses, thermal storage in large buildings, off-peak cooling), (II) solar energy (passive, photovoltaics), (III) utility load management ("smart meters," capital recovery fees, voltage control), (IV) appliances (life-cycle costs, refrigerators), and (V) lighting (isotopic enhancement).

22770 **Demand side experience in the Hood River Project.** Oliver, T.; Peach, H.; Quinn, D.; French, S. (Bonneville Power Administration-KRR, P.O. Box 3621, Portland, OR 97208). pp 558-563 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

In this field experiment, a non-equivalent control group time series design was employed to investigate the purchase of conservation energy resource obtained through residential retrofit weatherization. Levels of retrofit measures installed are higher than in current programs and are cost-justified in relation to the avoided cost of new coal plant. A community mobilization approach was adopted for the experiment, which was limited to dwellings with installed electric heat (whether or not currently used to heat the dwelling) in the semi-rural community of Hood River in the Pacific Northwest region of the United States.

22771 **The ELCAP residential base study: Selection procedures and distribution of the final sample.** Windell, P.A. (Bonneville Power Administration, Portland, OR). pp 570-584 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

The Base Study is one of seven residential sector studies being conducted as part of the Bonneville Power Administration's (BPA) End-use Load and Conservation Assessment Program (ELCAP). This paper describes the objectives to be served by the study and the procedures used to select the sample, and presents the results of preliminary analyses of selected characteristics of the final sample. Comparisons are drawn between the final sample of participants, the eligible frame, and the Pacific Northwest (PNW) regional population. Particular attention is paid to those characteristics which are likely to have significant effects on energy consumptions patterns.

22772 **Designing building metering experiments and the second law of ELCAP.** Stokes, G.M.; Hauser, S.G. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 96-105 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

Many load and conservation research issues appear to be best addressed through the collection of high-time resolution electrical consumption data from a large number of buildings. The sheer volume of the data collected in such programs can overwhelm an analyst. This is particularly true if the data is subjet to subtle quality problems that might bias the results. The design of the large building metering program known as the End-Use Load and Conservation Assessment Program (ELCAP) is presented as one approach that may eliminate some of the hazards inherent in large-scale metering programs. Key concepts in this design are a rigidly controlled method of documenting the metering protocol in individual buildings and the treatment of the entire metering effort, from field data acquisition system to final analysis, as an integrated system.

22773 **Early results from the Hood River Conservation Project.** Hirst, E.; Goeltz, R. (Energy Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 37-43 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

The Hood River Conservation Project (HRCP) is a major residential retrofit research and demonstration project. The project is being conducted in the community of Hood River, Oregon, will cost $21 million, and take three years (mid-1983 through 1986). HRCP is managed by Pacific Power & Light Company (PP&L) and funded by the Bonneville Power Administration (BPA). HRCP's primary purpose is to determine the size and cost of conservation resources in existing homes in the Pacific Northwest. The project seeks to install as many cost-effective retrofit measures in as many electrically-heated homes as possible. HRCP offers a package of "super" retrofit measures and pays for installation of these measures up to a cost-effectiveness limit roughly four times that in other residential retrofit programs in the region. Thus, HRCP offers the chance to determine levels of retrofit installation when cost to the household and prior retrofit activities are largely eliminated as barriers.

22774 **Energy management systems in large commercial buildings - Monitoring and control capabilities.** Akbari, H.; Warren, M.; Harris, J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 106-122 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

The number of existing Energy Management Systems (EMS's) in both retrofitted and new commercial buildings is significant and growing. To assess benefits of this technology to building owners, occupants, operators, and utilities, the major characteristics of EMS's currently available on the market have been reviewed in terms of their hardware, software, and intra- and inter-system communications capabilities. Examples of data collection by two types of EMS's have been given to show how the gathered information could be utilized by both building operators and utilities to document energy consumption and peak electricity demand in buildings. A brief discussion of the commonly offered load management software is presented. Finally, communications protocols that allow access to the data resident in the EMS are discussed.

3202 Transportation

22775 **(ORNL/TM—10074) Simulating the market for automotive fuel efficiency: The SHRSIM model.** Greene, D.L. (Oak Ridge National Lab., TN (USA)). Feb 1987. Contract AC05-84OR21400. 66p. NTIS MF A01; 2; GPO Dep. File Number DE87006019.

This report describes a computer model for simulating the effects of uncertainty about future fuel prices and competitors' behavior on the market shares of an automobile manufacturer who is considering introducing technology to increase fuel efficiency. Starting with an initial sales distribution, a pivot-point multinomial logit technique is used to adjust market shares based on changes in the present value of the added fuel efficiency. These shifts are random because the model generates random fuel price projections using parameters supplied by the user. The user also controls the timing of introduction and obsolescence of technology. While the model was designed with automobiles in mind, it has more general applicability to energy using durable goods. The model is written in IBM BASIC for an IBM PC and compiled using the Microsoft QuickBASIC (trademark of the Microsoft corporation) compiler.

22776 **(PB—87-133583/XAB) Cost effectiveness of park-and-ride lots in the Puget Sound region area. Final report.** Rutherford, G.S.; Wellander, C.A. (Washington State Transportation Center, Seattle (USA)). Oct 1986. 303p. NTIS, PC A14/MF A01.

A cost-effectiveness evaluation and a cost-benefit analysis was performed on a park-and-ride system consisting of 26 park-and-ride lots in the Seattle metropolitan area. Costs and benefits of the system were examined with respect to the user, the community at large, and the public agencies responsible for providing for the community's transportation needs. Using survey and other data as input, a model was developed to calculate the total incurred trip costs of both the park-and-ride trip and the corresponding trip not involving the park-and-ride lot. General results indicated that the park-and-ride system in the Seattle area is cost effective.

22777 **(PB—87-133732/XAB) Transport energy: determinants and policy. Final report.** Dunkerley, J.; Hoch, I.; Bouhdili, C. (Resources for the Future, Inc., Washington, DC (USA)). Sep 1985. 344p. NTIS, PC PC E12/MF E01.

Expanding oil consumption by the transportation sector, already a major oil consumer, poses an economic threat to many developing countries. The report presents an overview of past trends in transport energy consumption and analyzes these trends systematically via regression analyses based on data from 80 developing and industrial countries (including new data on total and sectoral fuel consumption, numbers of trucks and buses, GDP, gasoline and diesel prices, and demographic and geographic features). Results of these analyses are supplemented by case studies of India and Ecuador. Results reveal high-income and low-price elasticities for fuel consumption and suggest that, despite rising fuel prices, increases in fuel consumption and vehicle ownership will outstrip increases in economic activity. This situation will require adapted fuel-price policies, which are critical in explaining fuel consumption. However, given the low price elasticities, price policies should be supplemented by improving vehicle efficiency and truck load factors, providing attractive alternative forms of public transportation, and reducing road congestion.

22778 **(PB—87-133765/XAB) Personal, social, psychological, and other factors in ridesharing programs. Final report, September 1982-January 1984.** Ayele, M.; Byun, J. (Morgan State Univ., Baltimore, MD (USA). Center for Transportation Studies). Jan 1984. 110p. NTIS, PC A06/MF A01.

An in-depth investigation of the ridesharing programs in the Baltimore and suburban Washington, D.C. areas was needed in light of the apparent difficulty in increasing ridership. To understand personal, social, psychological and other factors affecting ridesharing programs, the Ridesharer Survey was administered. An Agency Survey was also performed to study the reasons for varying levels of effectiveness of ridesharing programs offered by different organizations. The objectives of the agency based survey were to find: (1) the relationship between employee size and the number of employees engaged in ridesharing programs; (2) the role of the Vango program in Maryland; and (3) the effectiveness of specific incentives offered by various agencies. The incentives included were: (1) free parking; (2) preferential parking; and (3) subsidies for ridesharers.

22779 **(PB—87-135331/XAB) West virginia transit-marketing manual: get on the Bus and Ride.** (West Virginia Public Transportation Div., Charleston (USA)). May 1984. 72p. NTIS, PC A04/MF A01.

The manual presents a marketing campaign for small- to medium-size transit systems developed by the West Virginia Public Transportation Division. The document includes newspaper ads and promotions, radio commercial text, public-relations approaches and sample news releases, text of public-service announcements, transit education-activity ideas, sample schedules, and rider's guides and directories. Together they can be used in a comprehensive campaign to promote transit system ridership. Much of the material is generic, and can also be used by transit systems in other areas. The document should be of special use to managers of transit services and their marketing staffs.

22780 **(PB—87-136958/XAB) Manual for planning, designing, and operating transitway facilities in Texas. Research report, April 1984-August 1985.** Mounce, J.M.; Stokes, R.W. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Sep 1985. 191p. (TTI—2-8-10-84-425). NTIS, PC A09/MF A01.

This manual is divided into two primary parts. These are: Transitway mainlanes and connections, and Transitway support facilities. Information presented within the transitway manual should promote uniformity of design and operational efficiency for transitway facilities in Texas.

22781 **(PB—87-137121/XAB) Transit marketing in Pennsylvania: a handbook of effective transit-marketing aids (revised edition).** (Pennsylvania Dept. of Transportation, Harrisburg (USA). Bureau of Public Transit and Goods Movement Systems). 1 Aug 1984. 111p. NTIS, PC A06/MF A01.

Revision of report dated July 1981, PB—82-173899.

The report provides an overview of the range of marketing approaches that can be used by smaller transit systems. The majority of the techniques described deal with providing user information (such as time-tables, maps, and transit-education programs), and promotion and advertising (such as newspapers and radio advertising, press releases, and billboards). The document does include some information on fares, service planning and development, public relations, and promotional campaigns. Each technique is illustrated with one or more examples from within Pennsylvania. The document should be of particular interest to transit managers of smaller properties and their marketing staffs.

22782 **(PB—87-137477/XAB) Economic factors in the provision of transportation services.** Taylor, R.S.; Sandler, R.D.; Butler, S.E.; Schneider, C.G.; Stephanedes, Y.J. (National Research Council, Washington, DC (USA). Transportation Research Board). 1986. 76p. (TRB/TRR—1074). NTIS, PC A05/MF A01.

Library of Congress catalog card no. 86-23678.

The 8 papers in the report deal with the following areas: some recent developments in benefit-cost analysis of a proposed rail-line relocation: a case study; employment impacts of the Surface Transportation Assistance Act of 1982; time-sheets analysis of interactions between transportation and manufacturing and retail employment; the economics of transporting solid wastes; transportation network investment problem - a synthesis of tree-search algorithms; alternative responses to the need for intercity buses in rural areas; Michigan intercity bus study: comparison of 1985 and 1977 user and ticket surveys; differential influence of an interstate highway on the growth and development of low-income minority communities.

22783 **(PB—87-137485/XAB) Total-factor productivity analysis of public transit.** Obeng, K.; Benjamin, J.; Addus, A. (North Carolina Agricultural and Technical State Univ., Greensboro (USA). Transportation Inst.). Oct 1985. 119p. NTIS, PC A06/MF A01.

Improvement of transit performance depends first on the ability to measure performance levels. The paper introduces the concept of total-factor productivity as a unified measure of transit performance. The approach uses the shift in the cost function of inputs and outputs as the measure of change in productivity. A three-stage least-squares estimation procedure was used to estimate model parameters. The technique was applied to 20 transit systems. Data was analyzed for the most recent 26-year period. Results indicate that there are no consistent trends in total-factor productivity. Productivity seems to increase and decrease in similar amounts year by year indicating that there is little change. This supports the hypothesis that there has been little technological improvement in the industry and that management decisions tend to compensate for productivity changes so that productivity remains stable over time when total inputs and outputs are investigated.

22784 **(PB—87-139036/XAB) Pressure gradient for heterogeneous flow of coal, sand, and iron in pipelines.** Qing, Y.X. (Technische Hogeschool Delft (Netherlands). Lab. of Fluid Mechanics). Mar 1986. 40p. (REPT—86-3). NTIS, PC PC E03/MF E01.

The existing relationships based on Durand's method to predict pressure gradients for slurry flow in pipelines appear to be inadequate when accounting for a wide range of variables such as particle size and relative density as well as concentration. Using the coal, sand, and iron-ore data collected from various literature sources with the aid of nondimensional analysis, new equations for the case of the heterogeneous flow regime were derived on the base of nondimensional parameters. The equations have the same structure for each material considered, but the coefficients are different.

22785 **(PB—87-139523/XAB) Energy use in transport: data report.** (Beca, Carter, Hollings and Ferner Ltd., Auckland (New Zealand)). Jun 1986. 139p. NTIS, PC PC E06/MF E01.

The document presents data on transport and energy use for 1984 calendar year with time trends. It updates NZERDC Report No. 27 which provided similar information for 1975. The report reviews the use of fuel in powering transport vehicles. It updates and extends information previously presented in NZERDC Report No. 27. The energy inputs to vehicle manufacture and transport infrastructure are not included, although these are known to be of similar magnitude to direct (fuel) energy.

22786 **(PB—87-147591/XAB) Small transit-system management handbook. Final report.** Grimes, G. (Michigan Dept. of Transportation, Lansing (USA)). Dec 1985. 293p. NTIS, PC A13/MF A01.

The handbook is designed to provide a basis for instituting, organizing, and maintaining small-transit systems. It is a practical guide to management, with detailed information about the many responsibilities and tasks facing actual or prospective managers of transit systems in small cities or rural counties. Management issues which are addressed include operations, personnel, maintenance, equipment, marketing, and evaluation. Although the handbook is directed specifically to Michigan's statewide public-transit program, much of it can be applied in other states.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 22138, 22158, 22359, 22796, 22796

22787 **(CONF-8611136—) Proceedings of the DOE/Industry Research and Development Sensor Working Group meeting, Chicago, Illinois: [Final report].** Emerson, D.B.; Whitworth, B.A. (Energetics, Inc., Columbia, MD (USA)). 14 Nov 1986. Contract AC05-85CE40741. 200p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87006159.

From DOE/Industry Research and Development Sensor Working Group meeting; Chicago, IL, USA (14 Nov 1986).

This report gives summaries and working group comments on the following pulp and paper sensor projects: in-situ combustion control, pulp consistency meter, lignin mass spectrometer for kraft cooking liquor, lime kiln temperature sensor, submillimeter laser for moisture and basis weight, capacitive dew point sensor, acoustic steam flow meter, and real-time, noncontact optical surface motion monitor. A caucus report on these projects and presentation aids are included. (DLC)

22788 **(DOE/CE—0178) The DOE Industrial Energy Conservation Program: Program summary.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). Dec 1986. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007153.

With its industrial partners, the Industrial Program has successfully developed over 20 new technologies now in commercial use. These technologies saved an estimated 38.9 trillion Btu in 1986, worth $156 million per year at an average energy price of $4 per million Btu. These completed technologies are only the leading edge of over 100 active R & D projects. More adaptable, fuel-flexible cogeneration technologies developed by the Program are an important contribution to industry's resilience to future energy shocks. New, higher-temperature waste heat recovery equipment and incrementally improved process technologies developed by the Program will help to moderate growth in the amount of industrial fuel use. Major process innovations are being pursued by the Program and private industry.

22789 **(DOE/ER/13306—7) The development of process design and control strategies for enhanced energy efficiency and productivity in the process industries: Final report for period November 1, 1984-May 31, 1986.** Morari, M. (California Inst. of Tech., Pasadena (USA). Dept. of Chemical Engineering). Mar 1987. Contract FG03-85ER13306. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006800.

The process industries are a major consumer of energy. This project was concerned with the development of design strategies and operating policies for the improvement of energy efficiency and productivity in the process industries. In particular, the design and operation of resilient processing systems and the operation of complex processing systems was investigated. Major emphasis was placed on those parts of the process which often determine energy consumption and efficiency, i.e., the energy management system, distillation separations, and chemical reactors. Fundamental and immediately applicable results were obtained. The theoretical developments were tested experimentally. These experiments allowed us not only to improve our theoretical work, but they also represented real-life demonstrations of the effectiveness of the methods and of the feasibility of implementing them in an industrial environment.

22790 **(DOE/ID/12550—2) Plastic film heat exchanger development project: Topical report.** Guyer, E.C.; Brownell, D.L.; Gollin, M.K. (Dynatech R/D Co., Cambridge, MA (USA)). 11 Apr 1986. Contract AC07-84ID12550. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007019.

This report presents the progress that has been achieved in the development of the plastic film heat exchanger system (PFHX). An earlier report presented the general performance and design characteristics of a steam recovery PFHX. This report reviews some additional material selection possibilities for the film surfaces and describes a prototype design of a plastic film heat exchange element. Also the facility for the elevated temperature testing of this element design is described and the test plan is presented.

22791 **(PB—87-137642/XAB) Feasibility of a central recovery facility for the metal finishing industry in Cook County.** Huff, J.; Huff, L. (Huff and Huff, Inc., La Grange, IL (USA)). Nov 1986. 139p. NTIS, PC A07/MF A01.

The technical and economic feasibility of a Central Recovery Facility (CRF) for electroplating wastes in Cook County, Illinois was investigated using market survey results and state-of-the-art technology. The electroplating waste streams, rinse streams, concentrated metal-bearing solutions (e.g., acid dip baths), and sludges from the associated waste-treatment systems were investigated as possible raw materials. Questionnaires were mailed to over 500 firms in Cook County and 105 were returned. From these questionnaires the potential size of a CRF was developed for each of the three waste streams. Process technologies were evaluated and cost estimates prepared to delineate the economics of such a facility. The compliance status of the industry was also determined, based upon baseline monitoring reports. The impact on the Cook County electroplaters resulting from the federal pretreatment standards was also determined by projecting the probable number of plant closures.

22792 **Electricity and innovation: Agents of revolution in American manufacturing.** Devine, W.D. Jr. (Institute for Energy Analysis, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, TN 37831-0117). pp 230-238 of Productivity through energy innovation. Smith, C.B.; Davis, T.; Keneipp, M. Elmsford, NY; Pergamon Books Inc. (1986). (CONF-8604109—).

From Pacific Gas and Electric (PG and E) energy expo; Oakland, CA, USA (29 Apr 1986).

The electrification of American manufacturing between 1880 and 1930 is recounted. Production and distribution of mechanical power rapidly evolved from water and steam prime movers with shaft and belt drive systems to electric motors that drove individual machines. Innovative electrolytic and electrothermic processes were developed for producing important chemicals and metals, and major new industries arose. These uses of electricity increased labor and capital productivity in manufacturing, reduced energy needs per unit product, and played a role in a major change in the relationship between total energy consumption and gross national product.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 22820, 23492

22793 **(CONF-860826—12) Summary of research activities and progress in utilization of municipal solid waste.** Lazar, J. (Argonne National Lab., IL (USA)). Aug 1986. Contract W-31109-ENG-38. 23p. NTIS, PC A02. File Number DE87006965.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

Landfill-gas-recovery systems and mass burning of municipal solid waste (MSW) "as received" in large waterwall combustors or in small modular systems to produce steam are the most technically developed MSW technologies. Although these technologies are in commercial use, research aimed at improving the economics and alleviating the environmental concerns still needs to be carried out. The technologies using refuse-derived fuel (RDF) are still in the research and development stage. Thermal gasification/pyrolysis and biological anaerobic-digestion processes, aimed at producing transportable liquid and gaseous fuels, continue to require research to be economically viable. The current research on new RDF-densification concepts and on the basic mechanisms in the pyrolysis and anaerobic digestion of waste for producing liquid and gaseous fuels is presented. A proof-of-concept bioconversion system, RefCoM (Refuse Conversion to Methane), is also described.

22794 **(DOE/CE/26529—T1) Assessment of district heating/cooling potential in Marquette, Michigan: Final report.** (Northern Michigan Univ., Marquette (USA); Cummins and Barnard, Inc., Ann Arbor, MI (USA); Borton (Thomas) Associates, Ann Arbor, MI (USA)). Feb 1987. Contract FG01-85CE26529. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006298.

A study of District Heating and Cooling was started in April 1985, and completed in February 1987. The study was funded by grants from the Department of Energy and the Michigan Energy Administration. A group of 14 individuals involved in local energy concerns served on the Assessment Work Group that provided basic data, review of consultant analyses and overall assessment of DHC opportunities in Marquette. Numerous DHC benefits were identified. 21 different scenarios of DHC were identified with variables of: thermal source, fuels to be used, distribution media, end users to be served, and cogeneration potential. The assessment of technical feasibility in Section 5 concludes that there is a substantial thermal load that could be supplied by central thermal distribution facilities which could displace more than 500,000 MCF equivalent of natural gas.

22795 **(DOE/CE/26531—T1) An assessment of district heating and cooling alternatives with waste-to-energy co-generation potential on the east side of the City of Milwaukee.** Tsao, K.C.; Swedish, M.J.; Kasun, D.J.; Bowser, B.A. (Wisconsin Univ., Milwaukee (USA). Dept. of Mechanical Engineering; Milwaukee Dept. of Public Works, WI (USA)). 15 Nov 1986. Contract FG01-85CE26531. 322p. NTIS, PC A14. File Number DE87004641.

This feasibility study covers the six significant components of any district heating and cooling (DHC) assessment project: (1) an analysis of thermal energy market potential; (2) an engineering analysis of thermal energy distribution system alternatives; (3) an engineering analysis of potential thermal energy generating sources; (4) an analysis of customer DHC system connection or hookup requirements; (5) project economics; and (6) institutional arrangements.

22796 **(DOE/METC—86/4068) Fluidized-bed combustion of scrap tires: Technical note.** Shang, J.Y.; Mei, J.S.; Notestein, J.E. (USDOE Morgantown Energy Technology Center, WV). Oct 1981. 35p. (CONF-811058—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86006593.

From International Flame Research Association meeting; Chicago, IL, USA (5 Oct 1981).

An introduction to fluidized-bed combustion (FBC) is presented in Section 2.0. Based on this discussion of its technical development, FBC is then presented as a means of scrap tire disposal. In Section 3.0, scrap tire disposal is reviewed in the categories of (1) physical applications, (2) chemical applications, (3) pyrolysis, and (4) incineration for thermal energy recovery. Scrap tire disposal is reviewed on the basis of (1) environmental acceptability, (2) conservation of resources, (3) impact on existing industries, (4) operational feasibility, and (5) special features. The focus of this report is the fluidized-bed incineration of scrap tires for thermal energy recovery. The factors that affect scrap tire combustion are discussed in Section 4.0. These factors are (1) agitation, (2) temperature, (3) excess air, (4) residence time, (5) feed uniformity, (6) solid waste handling, and (7) pollutants emission control. In reviewing these incineration processes, (1) fuel flexibility, (2) environmental acceptability, (3) combustion efficiency, and (4) operational reliability are discussed. The results from a tire incineration experiment conducted at the Morgantown Energy Technology Center are presented in Section 5.0, and a conceptual fluidized-bed combustor is discussed in Section 6.0. Future considerations in the FBC of scrap tires are discussed in Section 7.0. 8 refs., 6 figs., 6 tabs.

22797 **(DOE/NBM—7007412) Electric Energy Conservation and Production Project: Volume 1, Electricity use patterns.** (Blackfeet Indian Tribe, Browning, MT (USA); Black Hawk Associates, Denver, CO (USA)). Feb 1984. 57p. NTIS MF A01; 2; GPO Dep. File Number DE87007412.

The report addresses two major issues: the heavy reliance on electricity by residents of the Blackfeet Reservation in Montana, and the opportunities for electricity production from wind energy resources on the Reservation. The findings of this report help provide a basis for comprehensive energy management planning on the Reservation, analyze the potential for minimizing electricity demand and maximizing the efficiency of electrical end-uses through appropriate conservation measures, assess the potential of wind energy resources located on the Reservation, and identify and assess the technical, financial, legal, institutional, and regulatory issues involved in wind energy development within the Blackfeet Reservation. This volume covers electricity use patterns.

22798 **(DOE/NBM—7007416) City of Heyburn conservation plan.** (CH2M Hill, Boise, ID (USA)). Jan 1984. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007416.

The City of Heyburn, located in Southern Idaho, serves approximately 1100 electric consumers. Over 60% of the electric energy are for a single industrial consumer, the J.R. Simplot Company. The City receives all its power from BPA. Recent retail rate increases, coupled with the Northwest Regional Power Act, has prompted the City of Heyburn to develop a conservation plan compatible with the needs and desires of Heyburn consumers. The City's current conservation plan is to help the individual consumer conserve energy and to conserve on a system-wide basis. This report describes the programs that make up the plan.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

22799 **(DOE/CE—0172) Eighth annual report to Congress on the Automotive Technology Development Program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Heat Engine Propulsion Div.). Dec 1986. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005586.

This is the Eighth Annual Report to Congress on the implementation of the Automotive Propulsion Research and Development Act of 1978 (Title III of Public Law 95-238). It is intended to fulfill the reporting requirements of Sections 310(a) and 304(f), and is based on work currently in progress. In addition, it serves as a communication link between the Department of Energy's Automotive Technology Development Program and all of the interests involved in this Program.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 22189, 22805, 22808, 23253

22800 (DOE/CS/50058—T2) Diesel market penetration study. (COMSIS Corp., Wheaton, MD (USA). Professional Services Div.). 14 Nov 1985. Contract AC01-81CS50058. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87005093.

The seven tasks studied were: (1) compilation of data on diesel market penetration and consumer response to diesels; (2) a technical assessment of the diesel engine and its strengths and weaknesses as impacts consumer demand; (3) consumer behavior analysis using data compiled in Task 1; (4) assessment of fleet owner's experience with diesels; (5) determination of manufacturer's perspective toward diesels; (6) study of the European market experience with diesels; and (7) future outlook and final report.

22801 (EPRI-AP—4922) Third-party funding analysis model for an R and D combined-cycle plant: Final report. Williams, S.C. (Bechtel Group, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920316.

This model was used to analyze the funding alternatives for construction and operation during the five year durability test on an advanced gas turbine. The attached Example demonstrates the use of the model to study a cogeneration project. The model could be used for a variety of R and D projects that will be commercially operated after the initial testing period.

22802 (PB—87-130605/XAB) Calculation of 2-dimensional unsteady flow in inlet pipes and its application for V-8 engines. Tosa, Y.; Shimoda, K.; Olkawa, H. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1986. 7p. NTIS, PC PC E06/MF E01.

Included in Mitsubishi Juko Giho, Vol. 23, No. 5, 1-6(1986).

The automotive engine intake system simulation technique resorts to a two-dimensional representation by a modified fluid in cell method of unsteady flow only in such limited areas as branches and confluences, where their geometrical influence affects to the accuracy of the calculation. One-dimensional representation is used in other areas to improve the efficiency of the calculation. The technique was applied to the design of an optimum V-8 engine resonant intake system. A test engine with this intake system registered a 13% rise in volumetric efficiency in the low-speed range, without deterioration in the high-speed performance.

22803 (PB—87-130613/XAB) New combustion system of the IDI (indirect injection) diesel engine. Tateishi, M.; Imoto, K.; Inenaga, N.; Ishikawa, H.; Yamamoto, K. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1986. 7p. NTIS, PC PC E06/MF E01.

Included in Mitsubishi Juko Giho, Vol. 23, No. 5, 7-11(1986).

Increasing the degree of constant-volume heat release, combustion efficiency, and reducing the heat losses are of utmost importance for improving the fuel economy of indirect injection (IDI) diesel engine. The authors closely analyzed the flow characteristics of the jet passage and the jet in the main chamber, and successfully devised a new combustion system which features a refined jet passage. The new combustion system offers the optimum discharge coefficient of the jet passage and improved diffusion and penetration of the jet in the main chamber. Installed in a Mitsubishi S4E2 diesel engine (swirl-chamber system and four cylinders of 98 mm bore and 98 mm stroke each) and tested, the new combustion system was proven to reduce the engine's fuel consumption, smoke emission, and noise.

22804 (PB—87-130639/XAB) Study on piston slap-induced noise and vibration of internal combustion engine - theoretical analysis and simulation. Irie, Y.; Ohta, K.; Yamamoto, K.; Mine, K. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1986. 6p. NTIS, PC PC E06/MF E01.

Included in Mitsubishi Juko Giho, Vol. 23, No. 5, 19-23(1986).

The paper presents a numerical analysis procedure for predicting the piston slap-induced noise and vibration of internal combustion engines. In this method, the impact points between piston and cylinder liner are assumed to be at the upper and lower parts of the piston, an impact model with spring and a dash pot is employed to simulate the dynamic stiffness of the piston and the damping effect of the oil film. Furthermore, the dynamic characteristics of the cylinder liner attached to the engine block is considered to evaluate accurately the impact force and response of the liner. The method was applied to the piston-slap problem of an actual diesel engine and the calculated results of the liner acceleration were in good agreement with the measured data, thereby confirming the effectiveness of this method.

3302 External Combustion Engines

22805 (CONF-861002—Summs.) Twenty-fourth automotive technology development contractors' coordination meeting: Preprints. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Heat Engine Propulsion Div.). 1986. 508p. NTIS, PC A22/MF A01. File Number DE87001335.

From Automotive technology development contractors' coordination meeting; Dearborn, MI, USA (27 Oct 1986).

Separate abstracts were entered into the data base for each presentation. (MOW)

22806 (DOE/NASA/1005—11) RE-1000 free-piston Stirling engine sensitivity test results. Schreiber, J.G.; Geng, S.M.; Lorenz, G.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1986. Contract AI05-82OR21005. 130p. (NASA-TM—88846). NTIS (US Sales Only), PC A07. File Number DE87004810.

The NASA Lewis Research Center has been testing a 1 kW (1.33 hp) free-piston Stirling engine at the NASA Lewis test facilities. The tests performed over the past several years have been on a single cylinder machine known as the RE-1000. The data recorded were to aid in the investigation of the dynamics and thermodynamics of the free-piston Stirling engine. The data are intended to be used primarily for computer code validation. NASA reports TM-82999, TM-83407, and TM-87126 give initial results of the engine tests. The tests were designed to investigate the sensitivity of the engine performance to variations on the mean pressure of the working space, the working fluid used, heater and cooler temperatures, regenerator porosity, power piston mass and displacer dynamics. These tests have now been completed at NASA Lewis. This report presents some of the detailed data collected in the sensitivity tests. In all, 781 data points were recorded. A complete description of the engine and test facility is given. Many of the data can be found in tabular form, while a microfiche containing all of the data points can be requested from NASA Lewis.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 22622, 22623

22807 (CONF-8610122—10) A methodology to assess the impact of driving schedules and drive train characteristics on electric vehicle range. Hornstra, F.; Mulcahey, T.P.; Biwer, R.L.; Christianson, C.C.; Carothers, E.T.; Hogrefe, R.L.; Kulaga, J.E.; Webster, C.E. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004818.

From 8. international electric vehicle symposium; Washington, DC, USA (20 Oct 1986).

A methodology is described that combines the use of the battery Ragone (average power) and peak power characteristics, in a simple manner, to show which batteries and which drive train characteristics favor any one driving schedule over another, including the Federal Urban Driving Schedule (FUDS) and the SAE J227aD Urban Driving Schedule (SUDS). The methodology also reveals the energy remaining unused in the battery at the end of a discharge when the vehicle fails the requirements of the driving

schedule. The additional range achievable by relaxing the discharge terminating requirements of the driving schedule for a "limp home" can be determined. The methodology shows why batteries that have high peak power capability, while giving greater range, generally have less "limp home" ability.

3307 Emission Control

22808 **(AD-A—175763/2/XAB) Diesel emission survey at Dover AFB, Delaware. Final report, 7-10 January 1986.** Jenkins, J.C. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Nov 1986. 16p. (USAFOEHL—86-110EH0052LDB). NTIS, PC A02/MF A01.

HQ MAC/SGPB requested a survey of the 436 Aerial Port Squadron truck off-load section to evaluate the effects of diesel- and propane-powered forklift emissions. Carbon monoxide concentrations were measured with Ecolyzer Model 6000 and Foxboro MIRAN 1B real-time instruments. Air sampling to determine 8-hr time-weighted averages was conducted for nitrogen dioxide (Palmes passive diffusion device), nitric oxide (Palmes passive diffusion device), aldehydes (impinger with MBTH reagent), formaldehyde (impinger with 1% NaHSOs solution), and hydrocarbons and benzene (3M Organic Vapor Monitors 3500 passive diffusion badge). MSA colorimetric detector tubes were used to screen for sulfur dioxide and aldehydes. The concentrations of all substances sampled were below their respective TLV's. Recommendations included an increase in the dilution ventilation in the aerial port and the use of local exhaust ventilation or administrative controls to control worker exposures due to forklift operations in truck trailers. USAFOEHL suggests that initial monitoring of diesel exhaust emissions in enclosed facilities should increase measurements of both carbon monoxide and nitrogen oxides.

22809 **(PB—87-139168/XAB) Motor vehicle tampering survey - 1985. Final report.** Greco, R. (Environmental Protection Agency, Washington, DC (USA). Div. of Field Operations and Support). Nov 1986. 98p. (EPA—460/1-86/001). NTIS, PC A05/MF A01.

The Environmental Protection Agency conducted a survey of 6,586 light-duty motor vehicles for tampering with emissions control devices. All vehicles inspected were classified into one of four mutually exclusive categories: tampered (at least one control device removed or rendered inoperative), arguably tampered (potential, but not clear-cut tampering), malfunctioning, and okay (all control devices present and apparently operating properly). The results were: tampered - 20%, arguably tampered - 27%, malfunctioning - 1%, and okay - 52%. The survey also found that 9 percent of the unleaded vehicles were subject to fuel switching (using leaded gas in vehicles requiring unleaded fuel).

22810 **Rapid reduction of nitrogen oxides in exhaust gas streams.** Perry, R.A.; Siebers, D.L. (Sandia National Labs., Livermore, CA, USA). *Nature (London);* **324**: No. 6098, 657-658(Dec 1986).

Nitrogen oxides (NOsub(x)) play a major role in the formation of photochemical smog and in acid rain production. Some progress has been made in reducing NOsub(x) emissions through the use of combustion and exhaust control schemes, including three-way catalyst, staged combustion, and ammonia injection. Nevertheless, estimates indicate that the production of nitrogen oxides will continue to increase until the end of the century and beyond, if current trends continue. A new chemical process capable of completely removing NOsub(x) from the products of combustion is described. The effectiveness of this process is established in flow tube experiments, and the practical feasibility of this method is demonstrated by eliminating NOsub(x) from a portion of the exhaust from a single-cylinder diesel engine.

3308 Alternative Fuels

22811 **(CONF-861002—6) Industry perspectives summary: Results of feedback from industry.** Johnson, L.R.; Larsen, R.P. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02. File Number DE87007007.

From Automotive technology development contractors' coordination meeting; Dearborn, MI, USA (27 Oct 1986).

The Heat Engine Propulsion Division (HEPD) of the US Department of Energy's Office of Transportation Systems has a continuing interest in industry's viewpoints and opinions on the needs and focus of advanced research for transportation energy conservation. Industry Perspectives (IP) activities have been conducted by HEPD for the past four years to allow the private sector input into HEPD's Program planning and priority setting and to provide feedback on the content and progress of HEPD programs. In 1986, IP efforts were concentrated on the two major forums where HEPD's research results were presented: the 24th Automotive Technology Development Contractors' Coordination Meeting (CCM) and the Society of Automotive Engineers (SAE) Fuels and Lubricants Meeting. The SAE meeting was used to present the Alternative Fuels Utilization Program (AFUP) research activities. This reflects HEPD's interest in maximizing the exposure of its research results to industry, thus increasing the potential for rapid transfer of technology to those who would most benefit from it.

22812 **(CONF-861012—2) Rationale for converting the US transportation system to methanol fuel.** Larsen, R.P.; Santini, D.J. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02. File Number DE87004738.

From 7. international symposium on alcohol fuels; Paris, France (20 Oct 1986).

An alternative fuel eventually suitable for a large part of the transportation system should be introduced into the US market on a large scale by the mid-1990s. A necessarily long transition must be carefully planned to avoid rapidly increasing fuel prices; dwindling domestic oil supplies; and overdependence on the Mideast, a geographically concentrated and potentially unreliable fuel source. This paper summarizes the growing evidence that supports methanol as the preferred alternative fuel. This evidence is now sufficiently compelling to make the risk of starting a transition to this fuel lower than the risk of failing to do so. In spite of the short-term oil glut and because of long-run oil depletion trends, the US government should implement a smooth transition to methanol fuel. The benefits associated with making this transition are described, and estimates are given of the aggregate benefit to the US economy. Finally, arguments are presented for appropriate involvement of the federal government in the transition, given the possible repercussions if the lessons of history are not heeded.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

REFER ALSO TO CITATION(S) 23399, 23402

22813 **(LA—10940-MS) Optimal deployment of missile interceptors.** Bohachevsky, I.O.; Johnson, M.E.; Stein, M.L. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006323.

Ballistic missile defenses composed of one- and two layers of interceptors that protect multiple assets from attacks by several types of warheads are modeled mathematically. Investigated are the most effective divisions of resources between midcourse and terminal defenses and the optimal deployments of terminal interceptors.

3502 Proliferation

22814 Is further proliferation of nuclear weapons irrelevant to US national security. Pendley, R.E. (Los Alamos National Lab.). pp 97-107 of The nonproliferation predicament. Pilat, J.F. New Brunswick, NJ; Transaction Books Rutgers University (1985).

For almost four decades, the United States has insisted that any increase in the number of states possessing nuclear weapons should be discouraged, claiming that nuclear proliferation would undermine international security and stability, and threaten the national security interests of the United States. This view was clearly emphasized by the Reagan administration when the President stated in 1981 that the basis of US nonproliferation policy was to "establish the prevention of the spread of nuclear weapons as a fundamental national security and foreign policy objective." However, actual implementation of this policy, seeking to obviate moves toward increased regional nuclear capabilities, will call for a variety of bilateral security dealings with so-called problem countries in regions important to the United States, relationships that US governments have been largely chary of so far. It will also require discrimination and forcefulness in identifying the security interests of the United States in these key regions, and crafting specific foreign policies to further those interests.

22815 Arms control, nonproliferation, and US national security. Pilat, J.F. (Strategic Analysis Group of the Office of the Assistant Director for Planning and Analysis, Los Alamos National Lab.). pp 109-118 of The nonproliferation predicament. Pilat, J.F. New Brunswick, NJ; Transaction Books Rutgers University (1985).

The continuation of the arms race and the failure of arms control and disarmament negotiations lend support to the belief that US and Soviet power, prestige, and security depend upon nuclear weapons. Therefore, the argument goes, the non-nuclear-weapon states (particularly those that are not allied with nuclear-weapon states and do not share their nuclear shield) may conclude that they would be well served by possession of these weapons. In this sense, the failure of nuclear arms reductions could create incentives for further proliferation.

3503 Verification

REFER ALSO TO CITATION(S) 23407, 23408, 23409, 24177

22816 (PB—87-137584/XAB) Verification in all its aspects: a comprehensive study on arms control and disarmament verification pursuant to UNGA (United Nations General Assembly) resolution 40/152(o). (Government of Canada, Ottawa, Ontario). Apr 1986. 84p. NTIS, PC PC E04/MF E01.

Contents include: significance of verification; background (history, UNSSOD I, UNSSOD II, bilateral negotiations, multilateral negotiations); definitions, principles, procedures, and techniques (verification defined, the functions of verification, principles, procedures and techniques); verification: case studies (comprehensive nuclear test ban, chemical weapons, outer space); what countries can do - Canada's approach (the Canadian verification, research program, safeguards development); the future (the role of the UN).

36 MATERIALS

REFER ALSO TO CITATION(S) 22986

22817 (DOE/ER/45211—1) Experimental and theoretical studies of the structure of grain boundaries: Progress report. Ashcroft, N.W.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA)). Jan 1987. Contract FG02-85ER45211. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007560.

The long range goal of this research project has been to obtain information on the atomic structure of grain boundaries in bcc metals and ceramics, to understand how segregation influences grain boundary structure and causes boundaries to become embrittled in Fe-base alloys, to understand how segregation and ionization state of the solute influences the boundary structure in ceramic materials, and to understand the role of boron and nonstoichiometry in making brittle boundaries in Ni_3Al become ductile. A theoretical program was initiated during the period of this grant with the goal of understanding and improving the interatomic potentials that are used to calculate the structure of grain boundaries in metallic systems.

22818 (NBS-SP—726) Materials Information for Science and Technology (MIST): Project overview: Phase 1 and 2 and general considerations. Grattidge, W.; Westbrook, J.; McCarthy, J.; Northrup, C. Jr.; Rumble, J. Jr. (Sci-Tech Knowledge Systems, Scotia, NY (USA); Lawrence Berkeley Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA); National Bureau of Standards, Washington, DC (USA)). Nov 1986. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006799.

The National Bureau of Standards and the Department of Energy have embarked on a program to build a demonstration computerized materials data system called Materials Information for Science and Technology (MIST). This report documents the first two phases of the project. The emphasis of the first phase was on determining what information was needed and how it could impact user productivity. The second phase data from the Aerospace Metal Handbook on a set of alloys was digitized and incorporated in the system.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 22170, 22200, 22286, 22288, 22290, 22303, 22352, 22396, 22447, 22461, 22461, 22473, 22489, 22489, 22492, 22511, 22612, 22618, 22702, 22956, 23116, 23121, 23140, 23201, 23481, 23820, 24114, 24242, 24293

22819 (AD-A—175750/9/XAB) Determination of the incommensurately modulated structure of alpha-uranium below 37K. Technical report. van Smaalen, S.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Dec 1986. 45p. (UBUFFALO/DC—86/TR-26). NTIS, PC A03/MF A01.

The modulated structure of alpha-uranium is analyzed using the neutron-scattering data. The results of the refinements are given for all the superspace groups compatible with the neutron-diffraction pattern. Fits to the experimental data of equal quality are obtained for different structure models (different symmetries), thus prohibiting the determination of the structure from neutron scattering alone. Together with the recently reported results of electron microscopy, the refinements lead to an unique assignment of a superspace group to the incommensurately modulated structure of alpha-uranium below T = 37 K, with the tentative symbol P2/m11(beta)(gamma). The values of the structural parameters, as follow from the refinements, are also reported.

22820 (AD-A—175899/4/XAB) Corrosion of aluminum jackets on aboveground heat-distribution systems. Final technical report. Cooper, K.E.; Segan, E.G. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Sep 1986. 28p. (CERL-TR-M—86-17). NTIS, PC A03/MF A01.

Severe corrosion of aluminum sheet used as a protective jacket on aboveground heat distribution systems has occurred at several military installations. This study was conducted to determine the cause of this corrosion and to recommend revisions to guide specifications on the design, selection, and construction on insulation systems on aboveground systems. Used and virgin materials were tested to determine the source of failure. It was concluded that the pitting corrosion of the aluminum resulted from leachable chloride ion in the insulation system. Heavy-metal particles contributed to the attack by supplying cathode area. A number of corrective measures were recommended to minimize in future construction: (1) Reduce the acceptable level of leachable chloride ion in the insulation components to 50 ppm, (2) Limit the amount of heavy metals in the insulation system, (3) Require a leaching test of insulation components to ensure that soluble binders have a pH of 6 to 7.5, (4) Design the insulation system to prevent excessive ingress

of water from the outside and to prevent condensation of moisture on the inside of this aluminum jacket, (5) Design the vapor control system to prevent significant accumulation of water vapor, and (6) Avoid using a polyethylene coating on the aluminum jacket.

22821 **(CONF-861207—80) Characterization of rapidly solidified Al-Be-Li and Al-Be ribbons.** Oliver, W.C.; Wadsworth, J.; Pelton, A.R.; Nieh, T.G. (Oak Ridge National Lab., TN (USA); Lockheed Palo Alto Research Labs., CA (USA); Notre Dame Univ., IN (USA). Dept. of Materials Science and Engineering). 1986. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006613.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Rapidly solidified Al-Be and La-Be-Li ribbons have been produced by a melt spinning technique. Differential scanning calorimetry (DSC) measurements were conducted with both binary and ternary ribbons. A direct comparison of DSC results from binary and ternary ribbons indicates that the presence of Be has little or no effect on the precipitation of Li containing phases in the Al matrix (i.e., in this respect the ternary behaves like a pseudo binary Al-Li alloy). Mechanical properties microprobe measurements (MPM) and transmission electron microscopy (TEM) have been carried out on ribbons with a variety of heat treatments. Preliminary results show that the strength of Al-Be-Li ribbons, as a function of aging temperature, exhibits complex behavior. Specifically, the hardness first decreases with increasing annealing temperature up to 185°C, then increases with temperature up to 220°C and then decreases again. The binary alloy is not as hard in the as melt spun condition, but also shows a peak around 220°C. These results are explained in terms of precipitation of Li containing intermetallic compounds and Be from the matrix of the as melt spun alloys.

22822 **(CONF-861207—83) Epitaxial film growth study of single crystal V/Ce prepared by molecular-beam epitaxy on sapphire.** Homma, H.; Yang, K.Y.; Schuller, I.K. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 7p. NTIS MF A01; 2; GPO Dep. File Number DE87006976.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The growth of epitaxial films of cerium (Ce)/vanadium (V)/ on single crystal sapphires (α-Al_2O_3) was studied by in-situ reflection high energy electron diffraction and x-ray scattering. For the first time Ce(111) single crystal films was grown on V(110)/ Al_2O_3(1120) in the Frank-van der Merwe mode. A new epitaxial orientation, different from the well known Nishiyama-Wasserman or Kurdjumov-Sachs orientations is found in the present study. Subsequent V(110) layers grow epitaxially with three equivalent domains.

22823 **(CONF-861207—85) Characterization of Al and Al-Cr-Al thin films.** de Lima, O.F.; Lepetre, Y.; Brodsky, M.B. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006972.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

TEM, x-ray diffraction, and electrical resistivity measurements were used to study the microstructure and the growth of Al-Cr-Al film sandwiches, where the individual Al layers were 300 A thick and the Cr thickness was varied between 0 and 10 atomic layers. The base vacuum was around 1.0 x 10^{-10} torr, substrate temperatures varied between 100 to 350°C, and evaporation rates were 3 A/s for Al and ~0.1 to 0.2 A/s for Cr. All Al films had a strong (111) texture and showed a non-percolative island structure at 350°C. The films became connected at lower substrate temperatures, reaching perfect continuity at 100°C. However, electrical conductivity is achieved also for the films deposited at 350°C when one or more atomic layers of Cr are sandwiched between the Al layers. Results for the superconducting critical temperature and resistivity are discussed in terms of Cr diffusion into Al and the film size effect.

22824 **(CONF-861207—87) Nanocontact measurements in superlattices.** Baumann, T.; Pethica, J.B.; Grimsditch, M.; Schuller, I.K. (Argonne National Lab., IL (USA); Brown, Boveri und Co. Ltd., Baden (Switzerland). Research Center). 1986. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006974.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Many metallic superlattices are known to exhibit dramatic anomalous elastic properties as a function of modulation wavelength. All measurements to date measure either a shear modulus or a longitudinal modulus in the superlattice plane. Here we present a method which also probes longitudinal elastic behavior perpendicular to the layers using a nano-hardness tester. In this method, a diamond tip is indented into the material and both the indentation depth and applied force are constantly monitored during loading and unloading. The elastic properties are extracted from the unloading part of the force versus displacement curve. Contrary to the anomaly found in a shear modulus, no anomaly in Young's modulus was found in the present study on Mo/Ni superlattices.

22825 **(CONF-870142—11) Fermi surfaces of mixed valent and heavy fermion metals.** Norman, M.R. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006988.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

The Fermi surfaces and the de Haas-van Alphen effect are discussed for $CeSn_3$, CeSb, $CeCu_6$, UPt_3, UPd_3, $NPSN_3$. It is shown that local density band calculations (with the f electrons treated as either band or core states) are highly successful in interpreting Fermi surface related phenomena for heavy fermion, mixed valent, and other anomalous f electron compounds. (DLC)

22826 **(DOE/ER/45154—1) Mechanisms of transformation toughening: Final report.** Olson, G.B.; Parks, D.M.; Chen, I.W. (Massachusetts Inst. of Tech., Cambridge (USA)). 28 Feb 1987. Contract FG02-84ER45154. 39p. NTIS MF A01; 2; GPO Dep. File Number DE87006816.

Mechanisms of transformation toughening in ductible solids are investigated by (1) detailed observations of crack-tip processes and (2) numerical modelling with experimentally-derived constitutive relations. Two series of model alloy steels have been developed for convenient study of transformation toughening at room temperature and for detailed study of constitutive behavior. Constitutive relations based on strain-induced transformation kinetics are being refined for these homogeneous austenitic alloys and extended to dispersed-phase systems. Using alloy composition to vary phase stability, processes of shear-instability-controlled fracture at sectioned crack tips are observed with and without transformation plasticity interactions. Quantitative constitutive relations developed for the experimental alloys are applied to crack-tip and notch fields to study transformation plasticity interaction with various models of microvoid-softening-induced shear localization. A final stage of the proposed research involves generalization of derived concepts to related phenomena in other ductile solids.

22827 **(DOE/ER/45203—2) Influence of grain boundary structure distribution and processing history on intergranular creep cavitation: Progress report for period March 1, 1986-February 28, 1987.** Adams, B.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Mechanical Engineering). 12 Mar 1987. Contract FG02-85ER45203. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006922.

During the past year two new data sets were analyzed to construct the Intercrystalline Structure Distribution Function (ISDF) for seamless alloy 304 stainless steel tubing. The ISDF shows the unexpected property of isotropy in the physical orientation of special boundaries in this material. Further, although twin related CSL (coincident site lattice) boundaries are prevalent in the structure, other special CSL boundaries are noticeably absent. Some prevalent non-CSL special boundaries have been observed which occur with frequencies greater than random; this suggests that the geometric criterion of "specialness" in the CSL theory is

not sufficient for this material. As a consequence of the forementioned developments we have re-directed our research program to include further measurements of structure in alloy 304 stainless steel sheet in the ascrept condition. This new material condition will allow us to answer the important question of how general the condition of physical orientation isotropy is in this material. Continuing creep testing of this alloy will focus on uniaxial-axial test specimens aligned at variable angles relative to the sheet rolling direction. This testing will be completely unambiguous relative to the state of hydrostatic stress, and will facilitate a definitive clarification of any cavitation anisotropy which may occur in the structure. Further theoretical studies will include a quantitative identification of non-CSL special boundaries by Gaussian deconvolution of the measured ISDF, and an extension of the theory to include the structure of grain boundary triple junctions.

22828 **(DOE/ER/45239—1) [Surface studies at the NSLS]: Technical progress report.** (State Univ. of New York, Stony Brook (USA)). [1986]. Contract FG02-86ER45239. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006814.

The phase formed by 1/2 monolayer of Au on Cu[001] was determined to be a mixed layer of 50% Au-50% Cu (surface alloy). The valence band structure of this Cu[001] x (2 x 2)-Au phase is compared to Cu_3Au. (DLC)

22829 **(DOE/NASA/16310—2) Preliminary study of niobium alloy contamination by transport through helium.** Scheuermann, C.M.; Moore, T.J.; Wheeler, D.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 12 Jan 1987. Contract AI03-86SF16310. 19p. (NASA-TM—88952; CONF-870102—10). NTIS MF A01; 2; GPO Dep. File Number DE87006776.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Preliminary tests were conducted to determine if interstitial element transport through a circulating helium working fluid was a potential problem in Brayton and Stirling space power systems. Test specimens exposed to a thermal gradient for up to 3000 h included Nb-1%Zr, a Sm-Co alloy, Hiperco 50 steel, and alumina to simulate various engine components of the Brayton and Stirling systems. Results indicate that helium transport of interstitial contaminants can be minimized over a 7-y life with monometallic Nb-1%Zr design. Exposure with other materials indicated a potential for interstitial contaminant transport.

22830 (IA—1421, pp 106) **Diffusion of Cd and Hg in liquid Te.** Eger, D.; Yellin, N.; Ben Dor, L. (Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22831 (IA—1421, pp 79-80) **Influence of outgassing on the properties of hot isostatically pressed 304L stainless steel.** Dadon, D.; Yeheskel, O.; Gefen, Y. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22832 (IA—1421, pp 83-84) **Hydrogen trapping due to volume imperfections in iron based alloys.** Abramov, E.; Eliezer, D. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22833 (IA—1421, pp 82) **Thermotransport of hydrogen in Zr-2.5 wt% Nb alloy.** Stern, A.; Kneis, H.A.; Weatherly, G.C. (Israel Atomic Energy Commission, Tel Aviv; Toronto Univ., Ontario, Canada). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22834 (IA—1421, pp 82-83) **Hydrogen depth profiling in Zr-2.5 wt% Nb alloy.** Stern, A.; Katamian, D.; Weatherly, G.C. (Israel Atomic Energy Commission, Tel Aviv; Toronto Univ., Ontario, Canada). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22835 (IA—1421, pp 104) **Non-destructive rapid measurement of dopant distribution in Bi/sub 2/Te/sub 3/ based alloy crystals.** Sinvani, M. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22836 (IA—1421, pp 68-69) **Magnetic structures of HoFe/sub 5/Al/sub 7/. A neutron diffraction study.** Pinto, H.; Melamud, M.; Shaked, H. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22837 **(INIS-mf—10536) Materials resistant to seawater. Transfer of know-how from nuclear power plants to the offshore industry.** Lunde, L.; Johnsen, R. (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). Mar 1986. 32p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750687.

The report is a summary of the topics discussed at a two-day seminar at Institute for Energy Technology, Kjeller in August 1985. Experience with seawater corrosion in Nordic power reactor plants was discussed. There was also input from Danish experience with seawater corrosion in coal fired power plants. The following topics were dealt with: Experience in seawater cooling system materials, chlorination of seawater systems, and accelerated laboratory tests for stainless steels.

22838 (INIS-mf—10572, pp 13-24) **Post-irradiation research of prospective zirconium alloys.** Kocik, J.; Pav, T.; Kloc, K. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia; Vyvojovy Zavod Uranoveho Prumyslu, Zbraslav nad Vltavou, Czechoslovakia. Ustav Jadernych Paliv). 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701473. (CONF-8506335—Pt.2).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Samples of three zirconium alloys developed by UJP Zbraslav and a Valoy alloy sample were studied. The samples were irradiated in the WWR-S reactor at UJV Rez with fast neutron fluences ranging from 8.4 x 10/sup 22/ m/sup -2/ to 1.9 x 10/sup 24/ m/sup -2/ and at temperatures of 570 and 720 K. The radiation damage is described to the microstructure of irradiated alloys (the occurrence of dislocation loops) as is the effect of neutron fluence and irradiation temperature on the mechanical properties of the zirconium alloys and the Valoy alloy (shear strength, tensile strength, even ductility, total ductility and surface contraction) and the effects of annealing on the regeneration of microstructural changes and mechanical properties. The obtained results are compared with data given by other authors. (E.S.).

22839 (INIS-mf—10589, pp 178-179) **Softening in alpha zirconium polycrystals during deformation.** Trojanova, Z.; Lukac, P. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

22840 (INIS-mf—10589, pp 186-187) **Strengthening of alpha zirconium polycrystals.** Dlouhy, A.; Trojanova, Z. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

22841 (INIS-SU—392, pp 555) **Identification in zirconium alloys using Moessbauer spectroscopy.** Babikova, Yu.F.; Bateev, A.B.; Filippov, V.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

22842 (INIS-SU—392, pp 574) **Role of small γ-quantum doses in defect structure rearrangement in metals and alloys.** Filipenko, L.A.; Cherdantsev, P.A.; Chernov, I.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

22843 (INR—1961/14/R/B) **Hot cracking susceptibility of PAR-1 aluminium alloy evaluated in Houldcroft test.** (Institute of Nuclear Research, Warsaw (Poland)). 1982. 23p. (In Polish). Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

The description and results of hot crack susceptibility test of PAR-1 aluminium alloy are given. Technical conditions and mathematical analysis of Houldcroft test gave the possibility to evaluate the Hot Cracking Susceptibility Factor. The tests have been performed on the 3.2 mm thick sheets welded by TIG and TIG with filler metal grade SpA26.

22844 (JINR—E-14-85-789) **Transition from Kondo-lattice to intermediate valence state in Ce(Cusub(1-x)Nisub(x))sub(5) compounds.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701450.

Submitted to the journal Fiz. Tverd. Tela.

Measurements of the magnetic susceptibility, the low temperature specific heat capacity and the inelastic neutron scattering have been carried out on the continuous solid solution Ce(Cusub(1-x)Nisub(x))sub(5), $0<=x<=1$. The anomalous decrease of the susceptibility and of the specific heat capacity with the nickel concentration allows one to make a conclusion concerning the nature of transition from the Kondo-lattice system at $x=0$ to the intermediate valence system with $x=1$. 14 refs.; 5 figs.

22845 (Juel—2066) **Determination of gas-solid reaction kinetics in flowing dilute carrier gases using gas phase measurements.** Pfeifer, J.P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Jun 1986. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751339.

Corrosion testing of high temperature alloys in flowing helium containing traces of chemically active gaseous components at very low partial pressures leads to experimental difficulties because the partial pressures can change significantly as a result of the gas-solid reactions. The reaction rates are then reduced. These changes in partial pressure, however, provide under suitable selected conditions detailed in-situ information on the kinetics and the mechanisms of the gas-solid reactions. Using gas phase measurements, the rates of heterogeneous corrosion processes can be directly determined. The detection sensitivity is extremely good. The lowest measurable material flow rates are around 10/sup -14/ mol s/sup -1/ cm/sup -2/. The upper limit of the reaction rate is determined by gas phase diffusion. The diffusion transport is then only significantly faster than the surface reactions if the following equation applies: dn/dt 1/A x << 10/sup -4/ mol s/sup -1/ cm/sup -2/ (dn/dt reaction rate, A reaction surface, x mole fraction of the gas component).

22846 (Juel—2074) **Mechanism of hydrogen-permeation through oxidized metals.** Andritschky, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Jul 1986. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751338.

The mechanism of hydrogen permeation through high-temperature alloys and through oxidizied high-temperature alloys which probably will be used in the project 'Nukleare Prozesswaerme', is examined. The examined steels are 'Hastelloy X' and 'Inconel 617' which are, in a special oxidizing procedure, protected by an oxide layer (2-10 μm thick). The hydrogen permeation through oxidized metall alloys is described, a model of this work, by the volume parameters solubility and diffusion coefficient of the oxide and the alloy. Surface treatment of the oxide scale is of no influence on the permeation rate. The diffusion process through the oxide scale is described in the model by two parallel, independent paths. The first path is the diffusion through the undisturbed oxide, and the second path is understood as cracks, micropores or something else.

22847 (KFK—4083) **Heavy ion irradiation with 200 keV Ni-ions to study the swelling of iron and nickel and the technical alloys.** Exel, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau). May 1986. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751215.

Radiation induced swelling of iron, nickel and of the steels 1.4914 and 1.4970 was studied. Selection criterion for the materials was the equal lattice structure of iron and 1.4914 as well as of nickel and 1.4970. The relative bias factors of edge dislocations in iron and nickel were determined from swelling measurements. The experimentally determined bias factor in iron is lower than in nickel, in good agreement with calculated bias factors. The technical alloys 1.4970 and 1.4914 show the same maximum swelling. The opposite is known from swelling, induced by neutron- or MeV- ion irradiation. This may be explained by the modification in the chemical composition of the alloys, caused by ion implantation and by segregation. Dislocation- and loop structure are similar in iron and the martensitic steel 1.4914 with a predominant loop structure, whereas in nickel and the austenitic steel 1.4970 line dislocations are dominant.

22848 (KFK—4121) **Investigations of the influence of nitrogen and niobium on the tensile and creep-rupture behaviour of an austenitic 18/14 CrNi-steel. Final report.** Schirra, M.; Ritter, B.; Solano, B.R.; Barroso, S.; Rivas, M. de las. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Aug 1986. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751214.

The effect of the content of nitrogen (0,04% and 0,14%, resp. 0,018% and 0,18%) on the tensile and creep-rupture properties of an unstabilized and a Nb-stabilized 18/14 CrNi-steel has been studied at temperatures of up to 800/sup 0/C. The results show that a higher nitrogen content slightly increases the yield and ultimate tensile strength and decreases the total elongation, whereas the uniform elongation is left unchanged as compared to the values of the steel having the lower nitrogen content. The rupture time is also increased by the higher N- content, while the creep ductility remains nearly unchanged. The present results are compared to published data on the influence of the content of nitrogen for steels containing 15-18% Cr, 6-20% Ni, 0-10% Mn and 0-2% Mo.

22849 (KFK—4144) Thermophysical properties in the system Li-Pb. Jauch, U.; Karcher, V.; Schulz, B.; Haase, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Sep 1986. 86p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751344.

This report describes the work performed on the determination of the thermophysical properties of alloys in the binary system lithium-lead. The preparation of the Li(17)Pb(83) alloy and the intermetallic compound LiPb from the pure elements determines the contents of part 1 of the report, which includes too the characterization of the materials using chemical analysis, metallography, thermal and thermal differential analysis. Because of the great importance of the thermophysical behaviour of the liquid eutectic Li(17)Pb(83) for the design of a liquid metal breeder blanket in the next European Torus, part 2 of the report describes the measurements and results of the thermodynamic properties (latent heat of fusion, specific heat, density, thermal expansion and surface energy) of this alloy. The results of the determination of the transport properties (thermal and electrical conductivity and viscosity) are presented, too. In part 3 the methods are given, which lead to an estimation of thermophysical properties of Li-compounds with high Li-contents (> 50 at.%) in the solid state. Part 1, 2 and 3 have been entered separately into the database. (orig./GSCH).

22850 (KFK—4144, pp 2-24) Preparation and characterization of the Li(17)Pb(83) eutectic alloy and the LiPb intermetallic compound. Jauch, U.; Karcher, V.; Schulz, B. Sep 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751344.

In Thermophysical properties in the system Li-Pb.

Li(17)Pb(83) and LiPb were prepared from the pure elements in amounts of several hundred grams. The resolidified samples were characterized by melting points (eutectic temperature), chemical analysis and metallography. Using differential thermal analysis the heats of fusion were determined and the behaviour of the intermetallic phase LiPb in vacuum and high purified He was studied. The results from these investigations were applied to characterize Li(17)Pb(83) prepared in high amounts for technical application as a potential liquid breeder material.

22851 (KFK—4144, pp 25-44) Thermophysical properties of the Li(17)Pb(83) eutectic alloy. Jauch, U.; Haase, G.; Schulz, B. Sep 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751344.

In Thermophysical properties in the system Li-Pb.

Methods of measurements and results for the following properties of Li(17)Pb(83) are presented: density, specific heat, latent heat of fusion, surface energy, thermal conductivity and diffusivity, electrical conductivity and viscosity. The range of the temperature for extrapolation of the physical properties is discussed.

22852 (KFK—4144, pp 45-82) Estimation of thermophysical properties in the system Li-Pb. Jauch, U.; Schulz, B. Sep 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751344.

In Thermophysical properties in the system Li-Pb.

Based on the phase diagram and the knowledge of thermophysical properties data of alloys and intermetallic compounds in the Li-Pb system, quantitative relationships between several properties and between the properties in solid and liquid state are used: to interpret the results on thermophysical properties in the quasibinary system LiPb-Pb and to estimate unknown properties in the concentration range 100 > Li (at.%) > 50.

22853 (KFK—4150) Creep tests in base material and welded specimens of X6CrNi 1811 (DIN 1.4948) steel in the frame of AUSOL-program. 1. interim report (September 1986). Schirra, M.; Ritter, B.; Barroso, S.; Rivas, M. de las; Solano, R.R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Oct 1986. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751337.

The program AUSOL encompasses the creep-tests carried out with the austenitic steel CrNi in the frame of the German-Spanish collaboration (KfK-JEN). The material studied is the X6CrNi 1811 (DIN 1.4948) steel selected as structural material for the sodium-cooled fast breeder reactor SNR-300. They have been tested, base material and welded specimens, in the range 500-700/ sup 0/ C having reached experimental results up to 25 000 h. The results on creep-behaviour, time to rupture, ductility and previous metallographic and fractographic studies are presented, taking into account the comparative behaviour between base material and welded specimens. The results of creep behaviour and time to rupture fit in a dispersion margin corresponding to this type of steel. As expected the ductility of welded specimens is lower than the corresponding one to welded joints. It is scheduled to continue the program and with running tests it is expected to reach time to rupture up to 5x10/sup 4/ hours.

22854 (LA—10950-MS) Evaluation of the microstructure and mechanical properties of a Ti-6Al-4V shell. Follansbee, P.S.; Gray, G.T. III; Lopez, M.F. (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007710.

We describe work performed to evaluate the mechanical properties of a Ti-6Al-4V shell. Of particular interest were the mechanical properties at strain rates up to $\sim 10\ s^{-1}$. Two tasks were undertaken during this project. The first was a fundamental study of the deformation mechanisms in Ti-6Al-4V to identify the underlying rate controlling processes. The second task was a thorough evaluation of an actual Ti-6Al-4V shell, with the intent to characterize the microstructure and mechanical properties of a manufactured component. This latter task is the focus of this report. A simple constitutive law is proposed to describe the strain hardening and strain-rate sensitivity of the shell material. A much more extensive and physically based formulation for the constitutive behavior is presented in the Appendix.

22855 (LA-UR—87-310) Pressure dependence of the specific heat of heavy-fermion compounds. Phillips, N.E.; Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A.; Flouquet, J.; Amato, A.; Jaccard, D.; Fisk, Z.; Giorgi, A.L. (Lawrence Berkeley Lab., CA (USA); Centre National de la Recherche Scientifique, 38 - Grenoble (France). Centre de Recherches sur les Tres Basses Temperatures; Geneva Univ. (Switzerland). Dept. of Physics; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36;AC03-76SF00098. 11p. (CONF-870142—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006071.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

Although the electrical resistivity and the magnetic susceptibility of a number of HFC have been measured as a function of pressure, it is only recently that data for the specific heat (C) have become available for non-zero pressure. This paper describes measurements of C(P) to P ~9 kbar for $CeAl_3$, $CeCu_6$, UBe_{13}, and UPt_3. 33 refs., 11 figs.

22856 (LA-UR—87-438) Coherence in $CePd_3$. Lawrence, J.M.; Chen, Y.Y.; Thompson, J.D. (California Univ., Irvine (USA). Dept. of Physics; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870142—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006055.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

This paper presents results of resistivity and susceptibility measurements on $CePd_3$ and its alloys which support the existence of a third significant temperature, $T^* = 40K$. Anomalous pressure dependence of rho(T) occurs and nonmagnetic impurities cause large increases in rho(T) on this scale, which is distinct from and smaller than the scale T/sub max/ over which coherence first appears. Evidence is given that the magnetic form factor anomaly known to exist in $CePd_3$ arises on the same scale T^* suggesting that the 5d spin susceptibility which is responsible for the form factor anomaly is connected with the low temperature transport anomalies. The discussion is limited to the relationship of these results to other experimental measurements in $CePd_3$. In particular, we stress the relationship of these results to those of recent optical conductivity measurements which show that the quasi-particle effective

mass is strongly renormalized at low temperatures. This occurs over a temperature scale proposed for T*.

22857 **(LA-UR—87-455) Pressure dependence of the resistivity of Ce_3Al.** Lawrence, J.M.; Chen, Y.Y.; Thompson, J.D.; Borges, H.A. (California Univ., Irvine (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870142—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE87006057.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

Ce_3Al was prepared from very high purity cerium. The resistivity at various pressures show a structural transition near 100°K at zero pressure. This antiferromagnetic heavy fermion behavior evolves smoothly towards nonmagnetic large T/sub K/ (slightly overweight fermion) behavior as the pressure is raised. 3 figs. (DLC)

22858 **(NUREG/CR—4818) Transition range drop tower J-R curve testing of A106 steel.** Joyce, J.A.; Hackett, E.M. (Naval Academy, Annapolis, MD; David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Feb 1987. 31p. NTIS, PC A03/MF A01 - GPO. File Number TI87900552.

Fracture toughness properties should be measured in the laboratory at loading rates and temperatures similar to those expected in the application of interest. This is not usually the case because of the experimental difficulties involved. This report describes a method being used to obtain J/sub IC/, J-R curves, and J at cleavage for three point bend tests conducted at drop tower rates through the ductile to brittle transition regime of the ferritic A106 steel being tested. The major conclusion is that these tests can now be accomplished, though a high degree of expertise and considerable practical experience is necessary to obtain good test results. The steel tested here is quite rate dependent as shown both by tensile tests and fracture toughness tests. A load elevation of 30 to 50% results in the drop tower 100 in/second tests on this material in comparison with static tests when both tests are conducted on the ductile upper shelf. Nonetheless, for this material J/sub IC/ and J-R curves are not elevated by the loading rate. This result corresponds to a tendency for crack initiation to occur at a smaller bend angle for the high rate tests than for the static tests and a correspondingly greater amount of crack extension in the rapid specimen at a given bend angle beyond crack initiation than is present in the static test.

22859 **(ORNL/Sub—84-89603/01) Three-dimensional residual stress characterization of thick plate weldments with advanced measurement instrumentation and methodologies: Final technical report for period January 1984 to April 1986.** Ruud, C.O.; Snoha, D.J. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.; Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87007697.

A residual study was performed on a thirteen-inch thick, multi-pass, vee groove but weldment of 2-1/4 Cr 1 Mo steel alloy plate. The sample studies was about 13 inches thick by 9.5 inches along the weld by 35 inches normal to the weld, and was cut from a weldment several times larger along the weld and about 48 inches wide normal to the weld. Residual stresses were measured on the two rolled plate faces and on the two faces exposed by sectioning through the weld and which were normal to the weld center line. Nearly two thousand stress measurements were performed on each of the sample faces along several traverse lines and in two directions in the plane of the surface of the face. Several residual stress readings were performed at each location and the mean of these measurements plotted. The plots indicate the three-dimensional stress field extant in the sample. Further, the sample was cut in a plane parallel with the rolled plate surface to provide two sections about 2-1/4 inches thick and about 10-3/4 inches thick. The newly exposed face was mapped for residual stresses as well as one of the previously mapped faces. Nearly ten thousand residual stress measurements were performed on the thirteen-inch thick multi-pass HSLA steel weldment producing over seventy-two individual plots of stress traverses to provide the most thorough experimental analysis of a thick weldment to date. The data clearly illustrates the complexity of the three-dimensional residual stress state in thick multi-pass steel weldments and the magnitude of the difficulties to be faced in developing numerical models for residual stresses in these weldments.

22860 **(PNL/SRP-SA—14323) Hydrogen absorption and crevice corrosion behavior of Ti Grade 12 during exposure to irradiated brine at 150°C.** Westerman, R.E.; Telander, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 20p. (CONF-870306—40). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006439.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Ti Grade 12 alloy is being considered for use as a corrosion-resistant overpack for high-level nuclear waste packages in a salt repository. Two experiments performed at Pacific Northwest Laboratory (PNL) were directed toward determining this material's resistance to hydrogen absorption and crevice corrosion during exposure to concentrated anoxic Na/Mg/K chloride brines at 150°C under conditions of gamma irradiation. At an irradiation intensity of 2 x 10^4 rad/hr, the hydrogen absorption rate of Ti Grade 12 specimens was low, and appeared to stop entirely after six months. Grit-blasted specimens absorbed considerably more hydrogen than as-received sheet stock specimens. Crevice corrosion was observed between specimen spacers and between (purposefully) contacting specimens. The observed crevice corrosion susceptibility must be taken into account when considering the Ti Grade 12 alloy as a candidate waste package overpack material.

22861 **(PPA-PR—15) Preliminary investigations on the corrosivity of PUSPATI's tap water toward different types of steel.** (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701451.

The corrosivity of tap water toward three types of steel has been investigated. It was found that galvanised steels and stainless steels do not experience any significant weight loss after being immersed in tap water for 15 to 30 days. Mild steel, on the other hand, was found to lose 0.34% of its weight after an immersion of 15 days and 0.46% of its weight after 30 days immersion. Water analysis indicates that during the immersion, significant amounts of Fe/sup 3+/ ions were transferred from the metal surface into the solution. Results of the hardness measurement also suggest that CaCo3 scales which are loosely adhered to the surface of the metal have been formed. However, such layers are of no protective value and were removed during the cleaning of the specimen.

22862 **(PPA-T—55) Welding metallurgy of aluminium for radiation tube of reactor.** Mohamad Harun; Abdul Aziz Mohamad; Zailee Dollah; Azlan Samah; Jasmin Baba. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). May 1986. 24p. (In Malay). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701599.

The metallurgy of TIG weldment in aluminium alloy was examined based on physical metallurgy characteristics. The presence of weld defects have been detected by x-ray radiographic and metallographic methods. The lack of penetration in the aluminium weldment was possibly caused by the formation of aluminium oxide layer, insufficient heating flow and fast speed of work piece rotation. Segregation of major elements such as Mg and Si were varied between the weld zone and parent metal depending on the heat input during welding. Microstructure and microhardness across the weldment were markedly changed by heat-treatments. Minimum hardness was found in the heat-affected zone (HAZ) - fusion zone boundary and maximum hardness was found in the fusion zone. Both these extremes can produce premature failure of the weldment. Such failure especially embrittlement cracking could be hindered by heat-treated at 413/sup 0/C, 2 1/2 hours and furnace cooled, where the distribution of hardness has been minimized and homogenized.

22863 **(PPA-T—56) Effect of minor alloying elements on radiation damage evolution in stainless steel.** Mohamad Harun. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). May 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701600.

The report describes the experimental investigation of void swelling in solution-treated 316 stainless steels in the HVEM as a function of both temperature and boron contents. The specimens used in this study were 2 ppm and 49 ppm of boron content 316 steels. The specimens were irradiated at temperatures of 723, 773 and 823K to doses up to about 30 dpa with 1 MeV electron in a JEM-1000D High Voltage Electron Microscope. The damage rate was about 2 x 10/sup -3/ dpa/sec. The reflection vector use was (200). Defect clusters were formed at an early stage of the irradiation and continue to grow. Dislocation loops formed at the early stages of the irradiation were interstitial type and some voids were formed at higher irradiation doses. With the addition of a small amount of boron, the void swelling was prominently suppressed at the temperatures of 723, 773 and 823K with the highest swelling at 773K. There was also development of precipitates distributed in the matrix of both B-modified steels during the electron irradiation.

22864 **(RISO-M—2612) On transport of helium grain boundaries during irradiation.** Singh, B.N.; Foreman, A.J.E. (Risoe National Lab., Roskilde (Denmark)). Jun 1986. 26p. (CONF-860605—34). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750670.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The rate of accumulation of helium at grain boundaries is one of the important parameters determining the integrity and lifetime of the structural components of a fusion reactor. A diffusion calculation is made of the flux of helium to a grain boundary. The flux is found to depend on the gas production rate, the width of the cavity denuded zone and the cavity sink strength in the grain interior. The calculated accumulation of helium is in good agreement with the measured gas content of grain boundaries in Al, PE16 and 316 stainless steel. The flux of helium to grain boundaries increases with helium generation rate but the increase is less than proportional to the generation rate. The loss of helium to grain boundaries during the nucleation of the bubbles within the grains has been estimated; no great loss is expected to occur. However, the loss would be considerably enhanced if any delay in bubble nucleation were to occur due to incubation effects. The role of material variables is found to be difficult to predict at present.

22865 **(SAND—86-2570C) Wear resistance of metastable Ni-B alloys produced by chemical vapor deposition.** Mullendore, A.W.; Pope, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870388—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006134.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

A manufacturing application of the chemical vapor deposition of nickel from $Ni(CO)_4$ is the near-net-shape production of high-quality mold or die forms. In certain high wear applications, e.g., transfer molding of a glass-filled epoxy, erosive wear of the nickel die can compromise dimensional control of the product. We have investigated the atmospheric pressure deposition (at 150 to 155°C) of Ni-B from $Ni(CO)_4 + B_2H_6$ gas mixtures in order to develop alloys with improved hardness and wear resistance. The as-deposited alloys are metastable solid solutions of boron in nickel and contain up to 37 at. % boron. Evaluations of the alloys in the as-deposited and annealed states have included (in addition to structural studies) micro-indentation hardness and 1000-cycle pin-on-disc friction and wear studies using glass-filled epoxy pins. Two high boron alloys are shown to provide excellent resistance to wear from the glass-filled epoxy.

22866 **(SAND—86-2797C) Correlations between electrical contact resistance and stages of wear in 700 Torr helium for precious metal electrical contacts.** Peebles, D.E.; Pope, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870513—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003499.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

In situ pin-on-plate studies of wear between a gold based alloy plate and a palladium based alloy pin in a 700 Torr helium ambient demonstrate that irreversible and erratic increases in contact resistance arise as a result of incorporation of pin material and a corresponding increase in contaminant composition within the wear track.

22867 **(SAND—87-0096C) Tunnels at the silicon/tungsten interface: Causes and cures.** Blewer, R.S.; Headley, T.J.; Tracy, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870387—1). NTIS, PC A02. File Number DE87006124.

From Workshop on refractory metals and silicides; Aussois, France (24 Mar 1987).

The occurrence of 10 nm diameter tunnels in silicon beneath LPCVD tungsten films has been investigated over a wide range of wafer and deposition conditions. Two deposition techniques have been identified which suppress tunnels for wafer conditions studied in this investigation, thus providing an operational regime in which tunnel formation is not an issue.

22868 **(UCRL—15882) Thermal conductivity effects and process variables study: Final report covering the period 15 July to 15 October 1986.** Dorcic, J.; Cheng, J. (IIT Research Inst., Chicago, IL (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 33p. (IITRI-P—06059-1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006721.

Purpose of this program was to conduct a thermal conductivity effect and process variables study in order to establish a data base for the development of squeeze-cast plutonium hemishell-shaped components. Pure lead was selected as the study material because it has similar thermal properties to those of plutonium alloy. The low thermal conductivity (0.083 cal/m²/cm/°C/s) of lead provides a means of evaluating the effect of this property on the squeeze casting process in thin-section castings.

22869 **(UCRL—91409) The failure of aluminum compact shear specimens under mixed mode loading.** Riddle, R.A.; Streit, R.D.; Finnie, I. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA)). Jun 1985. Contract W-7405-ENG-48. 32p. (CONF-850679—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE87007090.

From 18. American Society for Testing and Materials symposium; Boulder, CO, USA (1 Jun 1985).

The failure behavior of 7075-T6 aluminum under combined Mode I and Mode II loading was investigated using the compact shear specimen. A limited number of additional mixed mode fracture tests were performed on an epoxy resin. The objective of the investigation was to determine the effects of mixed Mode I and Mode II loading on the failure behavior of these materials, considering such effects as the relationship between specimen geometry and failure loads, data reduction methods, crack growth versus limit load shear failure, and the direction of crack growth for mixed mode loading.

22870 **(UCRL—92885) Static high pressure studies on Nd and Sc.** Akella, J.; Xu, J.; Smith, G.S. (Lawrence Livermore National Lab., CA (USA); Carnegie Institution of Washington, DC (USA). Geophysical Lab.). 24 Jun 1985. Contract W-7405-ENG-48. 13p. (CONF-850759—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006691.

From 10. high pressure conference on research in high pressure science and technology; Amsterdam, Netherlands (8 Jul 1985).

We have investigated the crystal structural transformations in neodymium and scandium up to 4.0 GPa pressure and at room temperature, in a diamond-anvil high pressure apparatus. Nd has a double hexagonal-close packed (dhcp) structure at ambient pressure and temperature. Then it transforms to a face-centered cubic (fcc) structure at 3.8 GPa, which further transforms to a triple hexagonal-close packed structure (thcp) at about 18.0 GPa. In scandium we observed only one transformation from the hexagonal-close packed (hcp) structure at room temperature to a tetragonal struc-

ture. This transformation occurs between 19.0 and 23.2 GPa pressure.

22871 (UCRL—92887) Shock-impedance-match experiments at pressures to 2.5 TPa (25 Mbar). Mitchell, A.C.; Nellis, W.J.; Heinle, R.A.; Repp, G.W.; Moriarty, J.A.; Holmes, N.C.; Ross, M. (Lawrence Livermore National Lab., CA (USA)). Jun 1985. Contract W-7405-ENG-48. 19p. (CP—85-48; CONF-850759—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006690.

From 10. high pressure conference on research in high pressure science and technology; Amsterdam, Netherlands (8 Jul 1985).

Shock-impedance-match experiments were performed in proximity to underground nuclear explosions. Shock velocities were measured in pairs of adjacent materials. The reference material was Al in all cases. Specimens were Mo, Cu, Fe, Be, and graphite-phase C. Relative to a theoretical equation of state for Al, shock pressures in the specimens ranged up to 2.5 TPa. 20 refs., 7 figs.

22872 (UCRL—93392) Crystallographic considerations of the δ in equilibrium α displacive transformation in plutonium alloys. Adler, P.H.; Olson, G.B. (Lawrence Livermore National Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 10 Jun 1986. Contract W-7405-ENG-48. 6p. (CONF-860879—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005054.

From International conference on martensitic transformations (ICOMAT-86); Nara, Japan (26 Aug 1986).

Determination of invariant-plane strain crystallographic solutions for martensitic transformation between the FCC δ and monoclinic α phases in plutonium alloys, using three possible lattice correspondences and 53 possible lattice-invariant shear systems, identifies the most probable δ-α lattice correspondence. The operative lattice-invariant shear systems are predicted by comparison of both shape strain magnitudes and computed interfacial energies. For δ → α transformation twinning on (001) [100]/sub α/ is favored, giving a (.817, .538, .208)/sub δ/ habit and a [.947, .269, .174]/sub δ/ shape strain of magnitude m_1 = .324. The α → δ transformation favors slip on (111) [101]/sub δ/, giving a (.255, .844, .471)/sub α/ habit and [.822, .466, .355]/sub α/ shape strain of magnitude m_1 = .417.

22873 (UCRL—94500) Long-term corrosion behavior of copper-base materials in a gamma-irradiated environment. Yunker, W.H.; Glass, R.S. (Westinghouse Hanford Co., Richland, WA (USA); Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 13p. (CONF-861207—90). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007098.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

US DOE is currently evaluating the feasibility of using copper-base materials for the manufacture of nuclear waste containers. One site under consideration for geologic disposal of nuclear waste is at Yucca Mountain, Nevada. One feature of this waste repository will be the initial presence of ionizing gamma radiation at high dose rates, which may alter the corrosive medium. To evaluate such effects, three copper-base materials (pure copper, 7% aluminum-copper and 30% nickel-copper) have been exposed (presently up to 14 months) to a gamma radiation field of approximately 1 x 10^5 roentgens/hr. The exposure environments have been: (1) both groundwater (regional to the repository site, although taken from a lower elevation) at 95°C; (2) the water-vapor saturated air phase above it; and (3) air/water vapor at 150°C. In addition to uniform corrosion, both pitting and crevice corrosion have been observed. Characterization of the corrosion layers by x-ray diffraction has shown the presence of mixed copper(I) and copper(II) oxides. Studies by Auger Electron Spectroscopy (AES) have also been conducted in order to further characterize the compositions and structures of these corrosion products.

22874 (UCRL—95831) The structure of amorphous Be-Ti-Zr alloys. Jost, S.B.; Lee, A.E.; Wagner, C.N.J.; Tanner, L.E. (Lawrence Livermore National Lab., CA (USA); California Univ., Los Angeles (USA). Dept. of Materials Science and Engineering). 8 Dec 1986. Contract W-7405-ENG-48. 7p. (CONF-8608158—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003816.

From Liquid and amorphous metals 6; Garmisch, Partenkirchen, F.R. Germany (25 Aug 1986).

The structures of amorphous Be-Ti-Zr alloys with 40 at. % Be and 4, 10, 30, 50 and 60 at. % Zr, the remainder being Ti, have been determined employing the variable λ method with pulsed neutrons. The alloys with 10 and 60 at. % Zr were also measured with the variable λ x-ray method. Since Be is practically invisible for x-rays, the total structure factors are dominated by the Zr-Zr and Ti-Ti partial structure factors, respectively. The neutron data of the alloys with high Zr concentration allow us to determine by the topological short-range order, whereas the alloys with high Ti content yield directly the chemical short-range order.

22875 (VTT-TUTK—428) Fracture toughness correlations. Wallin, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Sep 1986. 66p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750892.

In this study existing fracture parameter correlations are reviewed. Their applicability and reliability are discussed in detail. A new K/sub IC/-CVN-correlation, based on a theoretical brittle fracture model, is presented.

22876 Effect of strain on the critical-current density of Cu-Nb composites. Klein, J.D.; Rose, R.M. (Department of Metallurgical Engineering, Michigan Technological University, Houghton, Michigan 49931). *Journal of Applied Physics;* **61**: No. 8, 2979-2982(15 Apr 1987).

Microfilamentary superconducting composites of Nb fibers in Cu matrices prepared by the stack and draw method were tested for tensile critical-current performance at 4.2 K. The superconducting critical-current densities increased exponentially under the influence of an applied mechanical strain until the onset of Nb fiber plastic deformation. In the elastic range, the critical-current densities conformed to $\log_{10}$ J/sub c/ = m (strain)+b. In several tests the critical current was increased by more than an order of magnitude by the applied strain. This behavior is consistent with an increase in the upper critical field of the Nb fibers by the applied stress.

22877 Reduction of tritium permeation through 304L stainless steel using aluminum ion implantation. Maienschein, J.L.; Musket, R.G.; McMurphy, F.E.; Brown, D.W. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* **50**: No. 14, 940-942(6 Apr 1987). Contract W-7405-ENG-48.

We have demonstrated the reduction of tritium gas permeation through 304L stainless steel using aluminum ion implantation. The implanted aluminum was selectively oxidized to form a thin, coherent, and stable Al_2O_3-rich layer on the stainless-steel surface. Tritium permeability at 100 and 170 °C was reduced 600—700-fold compared to clean stainless steel and 20-fold compared to stainless steel with native oxide. Since greater reductions are expected with improved Al_2O_3 layers, this approach is a promising alternative for reduction of permeation of all hydrogen isotopes through stainless steel and other materials.

22878 Positronium emission from lead. Howell, R.H.; Rosenberg, I.J.; Meyer, P.; Fluss, M.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **35**: No. 10, 4555-4560(1 Apr 1987).

We report positronium time-of-flight and two-dimensional angular correlation of annihilation radiation measurements of the momentum distribution of positronium emitted from the surface of a lead single crystal. Contrary to earlier estimates of positive values, lead is found to have a negative work function (-0.73 eV) for positronium emission. A confirmation of the positive work function for positron emission is obtained and a value of 2.06 eV is de-

duced. Lead exhibits a work function positronium yield typical of the sum of positronium and positrons for metals with negative positron work functions. Evidence for thermal desorption of additional positronium was obtained, indicating the existence of a positron-positronium surface trapped state. The present data is consistent with a general description of work-function positron and positronium production resulting from a common interaction with the traversed material.

22879 **Polarized light scattering investigation of UBe/sub 13/.** Cooper, S.L.; Klein, M.V.; Fisk, Z.; Smith, J.L.; Ott, H.R. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 W. Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **35**: No. 6, 2615-2618(15 Feb 1987).

The results of a Raman scattering study of single-crystal UBe/sub 13/ are presented and discussed. These results are compared with spectra from the isostructural compounds MBe/sub 13/ (M = La, Ce, Th), within the temperature range $3 \leqq T \leqq 350$ K. Ten phonons are observed in UBe/sub 13/, displaying symmetries $2A_1$/sub g/+4E/sub g/+4T/sub 2g/, consistent with predictions using the space- and site-group symmetries previously determined for this compound [space group O/sub h/^{6} (Fm3c)]. In addition, electronic scattering is evident in our spectra, exhibiting the symmetry of the purely antisymmetric representation, T_1/sub g/. Evidence suggests that this scattering results from localized excitations of the 5f electrons. Various interpretations of this scattering are discussed.

22880 **Scanning-tunneling-microscopy study of the Au(334) surface in air.** Salmeron, M.; Marchon, B.; Ferrer, S.; Kaufman, D.S. (Center for Advanced Materials of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **35**: No. 6, 3036-3038(15 Feb 1987).

High resolution images of a Au(334) surface in air have been obtained by scanning tunneling microscopy (STM). The surfaces were prepared in ultrahigh vacuum and produced clean Auger spectra and ordered stepped low-energy electron diffraction patterns. Exposure to air caused a small irreversible carbon contamination. The STM images in air revealed a structure of parallel steps of monatomic height grouped in domains that are several hundred angstroms wide and a few tens of angstroms high. These large domains are part of a surface that is smooth on the scale of several thousands of angstroms.

22881 **Neutron damage microstructures of high-conductivity copper alloys.** Livak, R.J.; Zocco, T.G.; Hobbs, L.W. (Los Alamos National Lab., LANL, NM, USA. Materials Science and Technology Div.; Massachusetts Inst. of Tech., Cambridge, USA. Dept. of Materials Science and Engineering). *Journal of Nuclear Materials;* **144**: No. 1/2, 121-127(Jan 1987).

Four high-conductivity copper alloys and two elemental coppers were neutron irradiated in the Experimental Breeder Reactor (EBR-II) at 385/sup 0/C to a maximum fluence of 2.0x10/sup 26/ n/m/sup 2/. Microstructural characterization using transmission electron microscopy revealed that large, faceted voids were produced in the MARZ-grade and oxygen-free coppers by the irradiation. The Cu-Cr-Zr-Mg (MZC) alloy did not show evidence of microstructural alterations after irradiation. In contrast to the MZC alloy, the Cu-Zr (AMZIRC) alloy underwent recrystallization and softening during irradiation. The alumina-dispersed copper alloys (Glidcop Al-20 and Al-60) exhibited the greatest resistance to neutron damage among the six materials tested.

22882 **First-principles study of the structural properties of Ge.** Chang, K.J.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8581-8590(15 Dec 1986). Contract AC03-76SF00098.

With the use of an ab initio pseudopotential method, the structural properties of Ge are investigated at normal and high pressures. The pressure-induced structural phase transitions from cubic diamond to β-Sn, to simple hexagonal (sh), and to double hexagonal close packed (dhcp) are examined. With the possible exception of the dhcp structure, the calculated transition pressures, transition volumes, and axial ratios are in good agreement with experimental results. We find that sh Ge has characteristics similar to those of sh Si; the bonds between hexagonal layers are stronger than intralayer bonds and the transverse phonon modes become soft near the transitions from the sh to β-Sn and the sh to hcp structures. At normal pressures, we compare the crystal energies for the cubic diamond, hexagonal 2H, and hexagonal 4H structures. Because of the similar sp^3 bonds in these structures, the structural energy differences are less than about 14 meV, and the 2H and 4H phases are metastable with respect to the cubic diamond structure. The equation of state is also presented and compared with experiment.

22883 **Iron on palladium (111) studied with photoemission, low-energy electron diffraction, and Auger-electron spectroscopy.** Binns, C.; Norris, C.; Williams, G.P.; Barthes, M.G.; Padmore, H.A. (Physics Department, Leicester University, Leicester LE17RH, United Kingdom). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8221-8229(15 Dec 1986).

Ultrathin Fe films on Pd(111) have been characterized by low-energy electron diffraction and Auger-electron spectroscopy and their electronic and magnetic properties studied by photoelectron spectroscopy using synchrotron radiation. By controlling the substrate temperatures during deposition it has been possible to grow islanded multilayer films, flat monolayer platelets, and flat bilayer platelets. Evidence is presented indicating that a flat Fe monolayer on Pd (111) is paramagnetic with a local moment of 1.2μ/sub B/. Small coverages in the second layers appear to induce ferromagnetic order. At coverages around two monolayers the films appear to pass through an antiferromagnetic phase.

22884 **Electron transport in La/sub 100-//sub x/Al/sub x/ metallic glasses.** Delgado, R.; Armbruester, H.; Naugle, D.G.; Tsai, C.L.; Johnson, W.L.; Williams, A. (Department of Physics, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8288-8295(15 Dec 1986).

Values of the electrical resistivity, temperature coefficient of resistivity, thermopower, and superconducting transition temperature for a series of La/sub 100-//sub x/Al/sub x/ metallic glasses prepared both as "splat-cooled" foils and "melt-spun" ribbons are reported. Differences between the two types of samples are discussed. We argue that the dominant contribution to the conductivity and thermopower is from La d states.

22885 **Linear augmented-Slater-type-orbital method for electronic-structure calculations. IV. 5d-5d alloys.** Watson, R.E.; Davenport, J.W.; Weinert, M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8421-8429(15 Dec 1986). Contract AC02-76CH00016.

We have used local-density calculations to study a series of transition-metal compounds which are isoelectronic with rhenium: WOs, TaIr, and HfPt. The calculations were carried out for two different crystal structures, CsCl and CuAuI. We find that the heats of formation are in reasonable accord with experiment and increase with the difference in atomic number. We also find a crossover in crystal structure from CuAuI for OsW and TaIr to CsCl for HfPt, which is consistent with experiment. Charge transfer in the series was investigated by Mulliken populations and by Wigner-Seitz sphere counts. These were compared with the shifts in contact density and core-level binding energy. We find that the change in contact density is consistent with electronegativity arguments and involves both changes in s count and d (or at least non-s) screening contributions. The changes in (initial-state) core-level binding energy do not follow the same trend—in fact, for two of the compounds, the change in binding energy relative to the Fermi energy has the same sign for the two constituents.

22886 **Magnetoresistivity of the spin-fluctuation materials $TiBe_2$ and UAl_2.** van Ruitenbeek, J.M.; van Deursen, A.P.J.; Myron, H.W.; Arko, A.J.; Smith, J.L. (Katholieke Universiteit, Toernooiveld 1, NL-6525 ED Nijmegen, The Netherlands and Max-Planck-Institut fuer Festkoerperforschung, Hochfeld Magnetlabor, Bote Postale 166 X, F-38042 Grenoble Cedex, France). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8507-8511(15 Dec 1986).

High-field magnetoresistivity (MR) measurements are presented for high-purity samples of $TiBe_2$ and UAl_2. The MR of $TiBe_2$ gives strong evidence for scattering due to spin fluctuations. The peculiar features in the MR around 5 T are apparently connected to the maxima in the susceptibility and may provide a clue to a theoretical description of the contributions of spin fluctuations to the resistivity. A value for the spin-fluctuation temperature is obtained and it is in agreement with earlier estimates. The MR of UAl_2 is consistent with the behavior of a compensated metal. From the high-field behavior of the MR we expect to observe de Haas—van Alphen oscillations above approximately 10 T, but up to 40 T no signals are found. A small negative MR at higher temperatures may be due to spin-fluctuation scattering, but the evidence is not as clear as for $TiBe_2$.

22887 **Optical spectral radiometric method for measurement of weld-pool surface temperatures.** Kraus, H.G. (Idaho National Engineering, Laboratory, EG & G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415). *Optics Letters;* **11**: No. 12, 773-775(Dec 1986). Contract AC07-76ID01570.

An new experimental method has been developed for making weld-pool surface-temperature field measurements. The method requires spectral measurements of the directional emissive power and the directional emissivity of the weld pool. The technique has been successfully demonstrated for measuring the weld-pool surface-temperature field for gas tungsten arc thin-plate SS 304 welds.

22888 **Preparation, properties, and some recent studies of the actinide metals.** Haire, R.G. (Oak Ridge National Lab., TN). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The actinide elements form a unique series of metals that have properties ranging from those characteristic of the d-electron transition metals to those of the 5f electron lanthanide metals. This wide range of physical properties together with the varying degree of availability of the different actinide elements offers a challenge for the preparative scientist. This article provides a brief review of some methods used for preparing the actinide metals, discusses some of their important properties, and summarizes the status of these properties. Recent studies on some of the heavier actinide metals are also discussed.

22889 **Formation of amorphous plutonium alloys or metastable structures in Pu-Fe, Pu-Ta, Pu-Si alloys.** Rizzo, H.F.; Echeverria, A.W. (Lawrence Livermore National Lab., CA). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The sputter deposition technique was used to study the possible formation of amorphous structures in Pu-Fe, Pu-Ta and Pu-Si systems. A triode sputtering system employing a split-target configuration of pure α-Pu and a selected solute element was used to prepare sputtered coatings: 13 to 59 at.% Fe, 10 to 50 at.% Si, and 15 to 65 at.% Ta. The Pu-Fe and Pu-Si binary systems showed strong evidence for the formation of amorphous phases in the sputtered coatings. In addition, the X-ray analyses indicated the presence of Pu_6Fe in the 13 to 20 at.% Fe range of Pu-Fe alloys and no apparent crystalline phases over the entire 10 to 50 at.% Si range of Pu-Si alloys. In the Pu-Ta system, the differential scanning calorimetry data obtained for compositions below 50 at.% Ta did not show typical crystallization exotherms. At compositions above 50 at.% Ta, a metastable b.c.c. α-Ta structure was observed with an expanded lattice parameter. The calculated volume expansion (2.9%) corresponds to 29 at.% Pu in solid solution if the lattice parameter is assumed to follow Vegard's Law. After storage in a nitrogen glovebox atmosphere for over two years the Pu-Si and Pu-Ta coatings maintained a metallic luster and showed no visible evidence of surface oxidation.

22890 **Lattice correspondence of the $\delta->\alpha$ displacive transformation in plutonium alloys.** Olson, G.B.; Adler, P.H. (Lawrence Livermore National Lab., NM). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

22891 **Systematic properties of actinide metals.** Ward, J.W. (Los Alamos National Lab., NM). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The solid state and thermodynamic properties of the 7th-row metals actinium through einsteinium are reviewed, particularly in terms of new advances since the Asilomar meeting. General properties for all the elements are considered, and the individual metals are surveyed for new results as well as for unresolved problems. The thermodynamic properties of the metals thorium through einsteinium are mostly well-established, except for the cohesive energy of protactinium. Here some unmeasured values still remain, particularly the high temperature heat capacities. The relation of 5f-electron bonding to 3d element behaviour is discussed in terms of the electronegativities of the elements, and the homologous shift of the metals americium through einsteinium to correspond with the series neodymium to europium is noted. Plutonium is characterized as an actinide trying hard to become a rare earth, and properties of the transition region are briefly discussed. A new understanding of f-electron bonding and structure has come from sophisticated calculations showing the effects of internal pressure, spin polarization energy and spin-orbit coupling. Recent high pressure results for the transplutonium metals shed light on these special materials.

22892 **Superconductivity in the actinides.** Smith, J.L.; Lawson, A.C. (Los Alamos National Lab., NM). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The trends in the occurrence of superconductivity in actinide materials are discussed. Most of them seem to show simple transition metal behavior. However, the superconductivity of americium proves that the f electrons are localized in that element and that actinides is the correct name for this row of elements. Recently the superconductivity of UBe_{13} and UPt_3 has been shown to be extremely unusual, and these compounds fall in the new class of compounds now known as heavy fermion materials.

22893 **Effects of 500 keV electron irradiation and subsequent annealing on 1/f noise in copper films.** Pelz, J.; Clarke, J. (California Univ., Berkeley; Lawrence Berkeley Lab., CA). pp 415-418 of Noise in physical systems and 1/f noise - 1985. Proceedings of the 8th international conference on Noise in physical systems and the 4th international conference on 1/f Noise, Rome, September 9-13, 1985. D'Amico, A.; Mazzetti, P. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8509249—).

From 8. international conference on noise in physical system and 4. international conference on 1/f noise; Rome, Italy (9 Sep 1985).

Includes author and subject indexes.

Polycrystalline copper films were maintained at 90K on the cold stage of an electron microscope and irradiated with 500keV electrons to induce defects. With an electron dose of about 5 x $10^{20}cm^{-2}$, the spectral density of the noise voltage across the films increased by an order of magnitude while the electrical resistivity increased by at most 10%. The films were annealed at progressively higher temperatures; after each annealing process the 1/f noise and resistivity were remeasured at 90K. Both the 1/f noise and resistivity were reduced, but at the lower annealing temperatures the fractional reduction in the added noise was substantially more than in

the added resistivity. These results suggest that a large fraction of the added noise may be generated by a small mobile fraction of the added defects that are more readily annealed than the majority of the defects. After a room temperature annealing process, both the noise and resistivity returned nearly to their initial values. The temperature dependence of the noise after irradiation and partial annealing was consistent with the Dutta-Dimon-Horn thermal activation model. (Auth.).

22894 **An analysis of heat-affected zone cracking in Ni/sub 3/Al alloys.** Santella, M.I.; Maguire, M.C.; David, S.A. (Oak Ridge National Lab.). pp 34-37 of Sixty-seventh American Welding Society annual meeting. Abstracts. Miami, FL; American Welding Society (1986). (CONF-8604123—).

From 67. annual American Welding Society meeting; Atlanta, GA, USA (13 Apr 1986).

The weldability evaluation showed that boron concentration had a strong effect on the cracking tendency of the iron-containing alloys. High welding speeds produced a high cracking frequency in IC-25 but not in IC-103. Gleeble tests showed that the lower boron alloy (IC-103) had significantly higher ductility in the range 1200 to 1250°C (2192 to 2282°F). Also, IC-103 had a systematically higher strength than IC-25 above 800°C (1472°F). The welding behavior of IC-50 was identical to that of IC-103. No HAZ cracks were detected in this alloy even at very high welding speeds. Gleeble testing showed that while IC-50 had very little ductility above 800°C, its strength values were the highest of all three alloys tested.

22895 **Hot cracking of hastelloy C-type alloys.** Cieslak, M.J.; Headley, T.J.; Romig, A.D. Jr. (Sandia National Labs., NM). pp 32-34 of Sixty-seventh American Welding Society annual meeting. Abstracts. Miami, FL; American Welding Society (1986). (CONF-8604123—).

From 67. annual American Welding Society meeting; Atlanta, GA, USA (13 Apr 1986).

As part of a program to determine optimum nickel-base alloys for fusion-welded hermetic electrical connectors, the fusion-zone and heat-affected zone (HAZ) cracking susceptibility of Hastelloy alloys C-4, C-22, and C-276 was investigated. In general, these alloys are not considered to be hot-crack sensitive, but the applications in which they are normally encountered do not place as stringent a requirement on joint integrity as in the present case. This investigation consisted of autogenous and dissimilar metal Varestraint hot-crack testing, Gleeble HAZ cracking studies, dissimilar metal laser-welded circular patch test, differential thermal analysis, and extensive optical and electron microscopy. A brief review of some of the testing and analyses is given. The results of autogenous Varestraint testing indicated that alloy C-4 had the best resistance to hot-cracking of the alloys studied while alloy C-276 had the greatest susceptibility to hot-cracking. All of the C-type alloys had superior weldability to Inconel 625. Optical metallography revealed a secondary solidification constituent along fusion zone hot cracks in both alloys C-276 and C-22. Microprobe analyses performed on these two alloys indicated that the interdendritic constituent was highly enriched in Mo and depleted in Ni.

22896 **Electron beam welding unit data acquisition using personal computer.** Milewski, J.O.; Dixon, R.D. (Los Alamos National Lab.). pp 19-20 of Sixty-seventh American Welding Society annual meeting. Abstracts. Miami, FL; American Welding Society (1986). (CONF-8604123—).

From 67. annual American Welding Society meeting; Atlanta, GA, USA (13 Apr 1986).

This paper describes the applications of a personnel computer to electron beam welding unit (machine) data acquisition. Quality assurance of electron beam welds is accomplished using several methods. The most popular are those employing a nondestructive technique on all or a sample number of parts, while the least favored are destructive. One other aspect of quality assurance, which is often discussed and which is generally resolved using administrative controls, is welding machine setup. In most cases when a reject part is detected, an analysis is undertaken to determine if it is a result of material, dimensions, cleaning, welding machine setup, etc. At this time one or more parts are destructively tested, and the process is shut down. This is expensive, and those actions which can minimize the expense should be considered. The availability of low cost computers, particularity personnel computers that are developing reputations for operating in industrial environments, has offered a solution to the hard copy data acquisition availability. This solution has become more attractive with the development and availability of simple straight forward interfaces for some of these computers. Added to this, there is a great amount of software offered to accommodate data acquisition and the display of the data. Further, the data can be archived on floppy discs or erased depending upon the needs of the organization.

22897 **Documentation of materials data for computer storage and retrieval.** Booker, M.K. (Oak Ridge National Lab., Oak Ridge, TN). pp 105-112 of Materials property data: Applications and access. Kaufman, J.G. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—). Contract AC05-84OR21400.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

In today's highly technological environment, successful design and production activities depend more and more on the availability of appropriate data describing materials behaviour. In complex applications, data involved can be vast, and massive data on materials behaviour are indeed being generated in various research programs around the world. The author and coworkers at the Oak Ridge National laboratory were actively involved in the design and implementation of early mechanical properties data base during the 1970s. This paper will draw from that experience to present a discussion of a few of the considerations that designers and operators of computerized materials data bases must consider to assure usefulness and efficiency. In particular, it will deal with the complex, but vital, problem of properly documenting and characterizing the data stored in computer data bases to assure, as far as possible, understanding and correct use of the data by persons accessing the data bases.

22898 **Evidence for internal dissociation during the oxidation of nickel metal.** Sankaran, S.; Mac Crone, R.K.; Shatynski, S.R. (Materials Engineering Dept., Rensselaer Polytechnic Institute, Troy, NY 12180-3590). pp 52-74 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—).

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

Magnetic resonance measurements on thermally grown NiO show discrete regions of nickel metal embedded in the oxide under certain conditions. The results of a detailed thermogravimetric study, magnetic resonance measurements and morphology of the oxides grown on nickel strips ground to surface finishes of 0.3μm to 50μm are presented and it is shown that the surface roughness prior to oxidation has a dominating effect. The oxidation of the samples were carried out in 10/sup 5/Pa oxygen at 1273°K for 2 to 16 hours. For a critical metal roughness of $\approx$ 20μm, the oxidation kinetics approach Wagerian prediction and the resonance intensity shows a maximum; these features are also accompanied by changes in the oxide morphology. It is proposed that deadhesion of the oxide at the oxide/metal interface caused by geometrical constraints takes place, and that the subsequent anisotropic dissociation of the oxide is responsible for the metallic regions. At the same time, the non ideal morphology gives rise to kinetics close to the ideal.

22899 **Statistical handling of PISC-II round robin NDE data.** Heasler, P.G. (Battelle Pacific Northwest Labs., Richland, WA). pp 273-274 of NDE reliability through round robin testing. Fong, J.T.; Mordfin, L.; Hedden, O.F.; Bush, S.H. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

The PISC trials may very well become one of the most valuable and extensive benchmarks of ultrasonic NDE performance for thick section welds. The results from the PISC-II trials will be available to the NDE community in two forms. First of all, the inspection results have been analyzed by Ispra with summaries of these results published under the direction of PISC. In addition, computer tapes of the inspection data will be available to those

members of the inspection community that are interested in conducting other analyses on the data. This presentation discusses the basic formats of the inspection data that will be made available from the PISC-II trials and suggests some general schemes for analysis-that might be applied to the data. The presentation also discusses certain features in the data that may be prone to mis-interpretation and perhaps mis-application, particularly to in-field inspection. Of particular concern in dealing with this data are: the role of false calls, interpretation of indications, and the role of human errors.

22900 **Cyclic softening effects on creep resistance of bainitic low alloy steel plain and notched bars.** Handrock, J.L.; Marriott, D.L. (Dept. of Mechanical and Industrial Engineering, Univ. of Illinois at Urbana-Champaign, Urbana, IL). pp 93-102 of Properties of high strength steels for high pressure containments. Nisbett, E.G. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

Consideration is being given to using low alloy steels such as 2.25 Cr 1 Mo steel, in a heat treated form to produce a bainitic microstructure with improved short term strength compared with the more commonly used annealed form. It has been found, however, that the bainitic structure softens significantly under cyclic loading, as a secondary effect of which the creep strength is also shown to be reduced. The investigation described is aimed at determining the effect of local cyclic softening on creep resistance of components. This has been done by performing load controlled creep tests on two types of notched bars, a relatively blunt Bridgman notch with an elastic SCF of 1.6, and a sharper Vee-notch with an ACF of 4.4, together with a small number of uniaxial specimens as controls. The material investigated is a low residual element 2.25 Cr 1 Mo steel manufactured by the basic oxygen process.

22901 **Effects of hold times, pre-notching, and environment on the elevated temperature fatigue life of bainitic 2.25 Cr - 1 Mo steel.** Kschinka, B.A.; Stubbins, J.F. (Univ. of Illinois, Urbana, IL). pp 87-92 of Properties of high strength steels for high pressure containments. Nisbett, E.G. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

Creep-fatigue-environment interaction in bainitic 2.25 Cr - 1 Mo steel is investigated. Tests were conducted in both air and vacuum at 566 C (1050 F) using a variety of strain-controlled waveforms in an effort to determine the influence of environment and cyclic waveforms on the material's fatigue resistance. A fully reversed strain range of 0.5% was utilized exclusively as this is a realistic estimate of actual service conditions and can be compared to several other studies which tested over larger strain ranges. This material is cyclic softening, which has important implications for allowable service stress and strain levels. Pre-flawed specimens were examined in an attempt to separate the effects of crack initiation and propagation. Tiny electro-discharge machined (EDM) notches reduced life by about 25% for tests in air, verifying that crack propagation is the dominant fatigue mechanism under these loading conditions.

22902 **Microstructure-mechanical property relationships in modified 3 chrome steels.** Todd, J.A.; Yeltekin, S. (Departments of Materials Science and Mechanical Engineering, Univ. of Southern California, Los Angeles, CA). pp 65-70 of Properties of high strength steels for high pressure containments. Nisbett, E.G. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

In this paper, the effects of Ni, Mn, Cr and Mo additions to 2.25Cr-1Mo steel have been studied. Microstructural evidence, from analytical transmission electron microscopy studies, is presented to show how these alloy additions modify the continuously cooled bainitic structures; tempering kinetics; and the structures and compositions of the alloy carbides compared to those observed in tempered commercial 2.25Cr-1Mo pressure vessel steels. The results indicate that significant improvements in hydrogen attack resistance and creep rupture properties can be achieved in 3Cr-1Mo-1Ni and 3Cr-1.5Mo steels by microstructural design based on Larson Miller Parameters.

22903 **Materials information for science and technology (MIST): A prototype material properties data network system.** Northrup, C.J.M. Jr.; Mc Carthy, J.L.; Westbrook, J.H.; Grattidge, W. (Sandia National Labs., Albuquerque, NM). pp 167-174 of Materials property data: Applications and access. Kaufman, J.G. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860722—).

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

There is a growing recognition that in today's computerized technical climate, a primary constraint on the productivity of many engineers and scientists is timely access to data in a computerized form. Substantial investments have been made in computer hardware and software for design and data analysis, but little has been done to computerize the information base essential to computer-based problem solving. An interagency effort has been initiated with the objective of developing a prototype material properties data system aimed at increasing the productivity of the members of the technical community who use computers to solve materials engineering problems. If successful, it will serve as a forerunner for similar systems in other fields of science and technology. The alternative that seems most promising at this time is an information system consisting of a network of quasi-autonomous databases, each specializing in a limited subject area, but unified by a common over-all data directory, consistent systems of nomenclature, and compatible data structures.

22904 **Oxidation behavior of chromium and a chromium-yttrium binary alloy.** Cotell, C.M.; Przybylski, K.; Yurek, G.J. (H.H. Uhlig Corrosion Lab., Massachusetts Institute of Technology, Cambridge, MA 02139). pp 103-127 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—).

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

The effect of an addition of 0.04wt%Y on the oxidation behavior of pure Cr at 900 and 1025°C has been investigated. The microstructures and chemical compositions of the Cr/sub 2/O/sub 3/ scales formed were studied both parallel and transverse to the oxide/metal interface by SEM, TEM and STEM. Oxidation kinetics were measured by TGA and the direction of scale growth determined using inert markers. At 900°C, the rate of scale growth, the direction of scale growth and the scale microstructure were unchanged by the addition of 0.04wt%Y to Cr. At 1025°C, the direction of scale growth and scale microstructure were unchanged by the addition of 0.04wt%Y, but the rate of oxidation was reduced by a factor of six. A model for the development of the microstructures of chromia scales formed on Cr and Cr-0.04wt%Y is presented, and the effect of yttrium on the rate of growth of chromia at 900 and 1025°C is discussed.

22905 **Non-parabolic growth in the sulfidation of iron.** Mc Kee, R.A.; Nguyen, T.A. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 12-18 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—). Contract AC05-84OR21400.

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

The authors present data that allow us to make a careful comparison between fundamental reaction kinetics and observations of the "time dependence" of iron sulfidation. These data are weight gain measurements, microstructural observations, and specimen geometry studies for iron reacting with sulfur vapor that has come either from H/sub 2//H/sub 2/S mixtures or from pure sulfur vapor. They can report three facts: (a) the fundamental reaction of iron to iron sulfide is parabolic at high temperatures (550-800°C, 10/sup -3/-10/sup 2/ Pa); (b) the absolute reaction rate is the same whether the reaction occurs in pure sulfur vapor or in H/sub 2// H/sub 2/S mixtures; and (c) weight gain measurements cannot be

systematically corrected to "parabolic" rates using specimen or area correction arguments.

22906 Measured and calculated stresses in Cr/sub 2/O/ sub 3/ scales and their Cr substrates. Stout, J.H.; Gerberich, W.W.; Lin, S.; Lii, M. (Dept. of Geology and Geophysics, Univ. of Minnesota, Minneapolis, MN 55455). pp 173-186 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—).

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

The development of growth stresses, thermal stresses and resultant residual stresses are analyzed by combining the results of x-ray diffraction measurements and a finite element method that models the distribution of those stresses. The observed normal component of residual stress in Cr/sub 2/O/sub 3/ grown on Cr at 900°C is compressive. The normal stresses in the coarser-grained substrate are also compressive, from which the authors calculate tensional in-plate stresses. The finite element analysis predicts the in-plane compressional stresses of the oxide in equilibrium with a substrate in tension. Comparison of these results with calculated thermal stresses indicates that a significant component of compressional growth stress has contributed to the observed residual stresses.

22907 In-situ observation of copper oxidation in a hot-stage environmental SEM. Onay, B.; Rapp, R.A. (Dept. of Metallurgical Engineering, The Ohio State Univ., Columbus, OH 43210). pp 215-225 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—).

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

Oxidation of OFHC copper under 10/sup -4/ atm. oxygen pressure has been studied in-situ with a hot-stage environmental scanning electron microscope (HSESEM). On specimens heated under the microscope vacuum, faceting and oxide formation along the surface steps were observed. At 900°C, a nearly uniform scale developed on electropolished specimens. Whiskers and cubic oxide crystals were observed on mechanically polished specimens oxidized at intermediate temperatures (700°C). The scale morphologies indicated bulk diffusion by means of point defects at 900°C and diffusion along short-circuit paths at 700°C.

22908 Segregation of sulfur to grain boundaries in chromia and alumina scales. Kim, Y.K.; Przybylski, K.; Yurek, G.J. (H.H. Uhlig Corrosion Lab., Massachusetts Institute of Technology, Cambridge, MA 02139). pp 259-284 of Fundamental aspects of high temperature corrosion - II. Shores, D.A.; Yurek, G.J. Pennington, NJ; The Electrochemical Society (1986). (CONF-860540—).

From 169. meeting of the Electrochemical Society; Boston, MA, USA (4 May 1986).

The oxidation of an Fe-25wt%Cr and an Fe-25wt%Cr-10wt%Al alloy at 900°C in H/sub 2/-H/sub 2/O gas mixtures containing small amounts of H/sub 2/S have been studied. The oxidation products were Cr/sub 2/O/sub 3/ and Al/sub 2/O/sub 3/ for the Fe-Cr and Fe-Cr-Al alloys, respectively. In the presence of H/sub 2/S, sulfur segregated to the grain boundaries in the oxide scales, which increased the rate of growth of Al/sub 2/O/sub 3/ and decreased the rate of growth of Cr/sub 2/O/sub 3/. Possible reasons for these effects are discussed.

22909 Electron emission and plasma formation during laser beam welding. Dixon, R.D.; Lewis, G.K. (Los Alamos National Lab., NM). *Welding Research Supplement;* 71.S-78.S(Mar 1985).

From 65. annual AWS convention; Dallas, TX, USA (8-13 Apr 1984).

A 400 watt average power Nd-YAG laser (1.06 micrometer wave-length) was used to study the effects of plasma generation on welding. Laser spot welds on aluminum and stainless steel were monitored optically, acoustically and electrically. Results show that the laser is optically coupled to the workpiece, significant current is emitted by the workpiece, current can be detected from the plasma, optical radiation emitted by the plasma generation can be monitored using microphones. The plasmas propagate as laser supported combustion waves and are expected to contribute significantly to heat input during welding. 10 references, 20 figures, 2 tables.

22910 Morphological instabilities and ion beam mixing in Ge. Appleton, B.R.; Holland, O.W.; Poker, D.B.; Narayan, J.; Fathy, D. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* 7/8: 639-644(1985). Contract AC05-84OR21400.

In light of the recent discovery that heavy ion irradiation initiates a morphological instability in the amorphous phase of Ge which erupts to form surface craters, previous studies of ion beam mixing in the metal/Ge system [2,4] are re-examined. Correlated ion scattering/channeling and cross-section electron microscopy are utilized to study the Au/Ge and Al/Ge systems under a variety of mixing conditions. Implications for both the crater formation and ion beam mixing mechanisms are discussed. 18 references, 6 figures.

22911 Thermal annealing of Fe implanted Al_2O_3 in an oxidizing and reducing environment. Farlow, G.C.; White, C.W.; McHargue, C.J.; Sklad, P.S.; Appleton, B.R. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* 7/8: 541-546(1985). Contract AC05-84OR21400.

The effects of ion implantation of Al_2O_3 followed by thermal annealing in a reducing environment have been studied and compared with the results obtained by annealing in an oxidizing environment. For the case of implanted Fe, partially coherent crystalline precipitates are observed after annealing in an oxidizing environment, and evidence is presented that crystalline precipitates of a different nature also form during annealing in a reducing environment. The precipitates which form in an oxidizing annealing environment have a major channeling axis nearly aligned with the Al_2O_3 (0001) direction. These precipitates are tentatively identified as Fe_3O_4. Lattice damage recovery is also different in the two annealing environments. 17 references, 5 figures.

22912 Materials failure prevention at the National Bureau of Standards. Schwartz, L.H.; Butrymowicz, D.B. (National Bureau of Standards, Gaithersburg, MD). pp 1-14 of Analyzing failures: The problems and the solutions. Goel, V.S. Metals Park, OH; American Society for Metals (1985). (CONF-851203—).

From International conference and exhibition on fatigue, corrosion cracking, fracture mechanic and failure analysis; Salt Lake City, UT, USA (2 Dec 1985).

As a Commerce Department agency, the National Bureau of Standards provides the measurement foundation that our industrial economy needs. Crucial to these needs are the safe, efficient, and economical use of materials. The NBS programs that support generic technologies in materials and the mechanisms by which fundamental information is transferred are analyzed. Specific examples are drawn from recent developments in fracture of materials.

22913 Comparison between experimental and analytical (empirical) results for surface flaws. Reuter, W.G. (EG and G Idaho, Inc., Idaho Falls, ID). pp 341-350 of Analyzing failures: The problems and the solutions. Goel, V.S. Metals Park, OH; American Society for Metals (1985). (CONF-851203—).

From International conference and exhibition on fatigue, corrosion cracking, fracture mechanic and failure analysis; Salt Lake City, UT, USA (2 Dec 1985).

The primary concern of this research is the ability to predict the behaviour (initiation of crack growth, crack growth, and instability) of structures containing defects. But, due to present limited capabilities the emphasis is on crack initiation. This paper presents comparisons between experimental results obtained from surface-flawed specimens with predictions based on K/sub Ic/ and J/sub Ic/ plus a few existing analytical solutions. The conditions evaluated range from linear elastic to fully plastic. Because the conditions

for a J-controlled field were exceeded in some instances, an empirical correlation is also provided.

22914 **The relationship between hydrogen-induced thresholds, fracture toughness and fracture modes in IN903.** Moody, N.R.; Stoltz, R.E.; Perra, M.W. (Sandia National Labs., Livermore). pp 43-54 of Corrosion cracking. Goel, V.S. Metals Park, OH; American Society for Metals (1985). (CONF-851203—). Contract AC04-76DP00789.

From International conference and exhibition on fatigue, corrosion cracking, fracture mechanic and failure analysis; Salt Lake City, UT, USA (2 Dec 1985).

The effect of hydrogen concentration and grain size on sustained load cracking thresholds and rising load fracture toughness has been studied in the high strength Fe-Ni-Co superalloy, IN903. Sustained load crack growth tests in 207 MPa hydrogen gas show that thresholds increase from 30 to 40 MPa-m/sup 1/2/ as the grain size increases from 23 to 200 μm. In contrast, fractures toughness values determined from precracked, gas phase charged samples are independent of grain size. Sustained load cracking in hydrogen gas is typified by an intergranular fracture mode at small grain sizes and a mixed intergranular and slip band fracture mode at large grain sizes.

22915 **Resolvability of defect ensembles with positron annihilation studies.** Fluss, M.J.; Howell, R.H.; Rosenberg, I.J.; Meyer, P. (Lawrence Livermore National Lab., CA). *Materials Research Society Symposia Proceedings;* **41**: 63-69(1985). Contract W-7405-ENG-48.

Recent advances in the use of positron annihilation to study defect ensembles in and on the surfaces of metals, are pointing the way towards studies where particular positron-electron annihilation modes may be identified and studied in the presence of one another. Although a great deal is understood about the annihilation of positrons in ostensibly defect free metals, much less is understood when the positron annihilates in complex defect systems such as liquid metals, amorphous solids, or at or near the vacuum-solid interface. In this paper the results of three experiments, all of which demonstrate means by which the authors can resolve various positron annihilation channels from one another, will be discussed. 7 references, 3 figures.

22916 **In situ HVEM studies of electron-beam-driven composition changes in thin film alloys: displacement-rate gradient effects.** Okamoto, P.R.; Lam, N.Q. (Argonne National Lab., IL). *Materials Research Society Symposia Proceedings;* **41**: 241-246(1985).

In situ high-voltage electron microscopy (HVEM) observations have shown that the highly-focused electron beams normally employed for HVEM irradiation experiments can cause large chemical composition changes in the irradiated zone of thin film alloys during elevated temperature irradiations. The driving force for the process comes primarily from the radial gradients in displacement rates generated by the beam. Hence, the rate of change in composition exhibits a strong dependence not only on the temperature and beam intensity, but also on the spatial characteristics of the beam profile. This dependence on beam shape and size poses previously unrecognized problems, particularly for HVEM studies of the effects of dose-rate on radiation-induced phenomena that are sensitive to alloy composition. Moreover, composition changes driven by radial gradients in the displacement-rate occur at increasingly rapid rates as the beam diameter is reduced. Hence, at higher voltages, beam-induced composition changes occurring during analysis may become a serious problem, even at relatively low temperatures, for microchemical analysis techniques, such as EDX and EELS, which employ far smaller diameter electron beams than those used for irradiation purposes of the HVEM. 5 references, 4 figures.

22917 **Characterization of atomic defects and their aggregates using positron annihilation spectroscopy.** Siegel, R.W.; Fluss, M.J.; Smedskjaer, L.C. (Argonne National Lab., IL). *Materials Research Society Symposia Proceedings;* **41**: 49-56(1985).

Positrons localize in trapped states at a variety of defect sites in solids, from which they subsequently annihilate with unique observable characteristics. As such, the positron is a valuable probe for the study of these defects. Positron annihilation spectroscopy (PAS) has made significant contributions in recent years to the determination of atomic defect properties in metals and alloys, and in molecular solids as well. It has also been used extensively in the monitoring and characterization of vacancy-like microstructure development, as occurs during post-irradiation annealing. The characterization of defects using PAS is selectively reviewed and some possibilities for using the positron as a localized probe of the atomic and electronic structure of atomic defects and their aggregates are discussed. 32 references, 4 figures.

22918 **Microstructural analysis of rapid solidification and undercooling in the Al-Ge system.** Kaufman, M.J.; Fraser, H.L. (Univ. of Illinois, Urbana). *Materials Research Society Symposia Proceedings;* **28**: 335-342(1984). Contract AC02-76ER01198.

Submicron powders, amorphous films and melt spun ribbons of various Al-Ge alloys have been analyzed to determine the relative roles of undercooling and cooling rate in the production of non-equilibrium structures. All analyses were performed in transmission electron microscopes equipped with energy dispersive x-ray spectrometers. The submicron powders, produced by electro-hydrodynamic atomization, were analyzed in their as-received condition and then annealed and/or melted using the electron beam as a local heating source. Once molten, the liquid droplets were undercooled at different cooling rates by varying the rate of beam obstruction. In this manner, a number of different microstructures were produced. These included metastable crystalline phases and mixed amorphous/crystalline structures. By combining this technique with a microscope heating stage, it was possible to carry out controlled dynamic undercooling experiments and determine phase selection as a function of undercooling and composition. The amorphous films were rapidly heated with the electron beam in the microscope and metastable as well as stable phases were produced. The results of these complementary analyses will be compared and discussed with reference to current models and theories of rapid solidification. 11 references, 6 figures, 1 table.

22919 **Wear of laser processes cast iron.** Chen, C.H.; Keshavan, M.K.; Altstetter, C.J.; Rigsbee, J.M. (Univ. of Illinois, Urbana). pp 183-197 of Laser processing of materials. Mukherjee, K.; Mazumder, J. (eds.). Los Angeles, CA; Metallurgical Society of AIME (1984). Contract AC02-76ER01198;AC02-78ER10004.

From 113. AIME annual meeting; Los Angeles, CA, USA (26 Feb-1 Mar 1984).

Laser processing of ductile cast iron can produce surfaces with unique, metastable microstructures which are very erosion/abrasion resistant. This paper discusses relationships between the laser processing parameters, the resulting microstructures and the wear characteristics/mechanisms for slurry erosion and abrasion. 20 references, 9 figures, 3 tables.

22920 **High coverage states of oxygen adsorbed on Pt(100) and Pt(111) surfaces.** Derry, G.N.; Ross, P.N. (Lawrence Berkeley Lab., CA). *Surface Science;* **140**: 165-180(1984). Contract AC03-76SF00098.

Oxygen adsorption on the Pt(100) and Pt(111) surfaces was investigated using x-ray photoemission and thermal desorption spectroscopies. Low pressure (ca. 10^{-5} Pa) oxygen dosing at near ambient crystal temperature resulted in the formation of dissociated adsorbed species at saturation coverages of nominally 0.2-0.25 monolayer on both surfaces. The combination of higher pressure (ca. 10^{-3} Pa) and higher surface temperature (570 K) dosing produced a three to five times higher saturation coverage than the low pressure dosing. The effect of dosing condition on the saturation coverage appears to reconcile apparent discrepancies for the Pt(100) surface in the literature. Characterization by XPS of the higher coverage state for oxygen showed that it is in the same chemical state as the oxygen adsorbed at very low coverage. Angle-resolved XPS has shown that in all cases the oxygen appears to reside on the surface with no significant penetration of oxygen into the bulk, as would be characteristic of oxidation. However, some penetration on the surface by oxygen, such as by a place-exchange type restructuring of the first two atomic layers, cannot be entirely ruled out. 34 references, 8 figures.

22921 Diffusion and interaction with vacancies of non-transition-metal solutes in some FCC metals. Chakraborty, B.; Smedskjaer, L.C.; Rothman, S.J. (Argonne National Lab., IL). *Journal of Physics F (London). Metal Physics (London);* **14**: 301-308(1984).

The authors suggest that the potential around non-transition-metal solutes in Ni is similar to the screened Coulomb potential that has been used to rationalize the diffusion of solutes in noble metals, and the behavior of Ge in Ni is analyzed on this basis. For Zn in Al, a self-consistent calculation of the electronic structure indicates that the potential around Zn is screened within a short distance from the Zn site and is of an oscillatory nature near the nearest-neighbor position. Such a potential may explain the lack of systematic variation of the activation enthalpy for solute diffusion in aluminum with solute valence. 26 references, 3 figures, 1 table.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 22826, 22897, 22912, 23179, 23246

22922 (BNL—39422) Sites and diffusion for muons and hydrogen in titanium hydrides. Kossler, W.J.; Schone, H.E.; Petzinger, K.; Hitti, B.; Kempton, J.R.; Seymour, E.F.W.; Stronach, C.E.; Lankford, W.F.; Reilly, J.J. (College of William and Mary, Williamsburg, VA (USA); Warwick Univ., Coventry (UK); Virginia State Univ., Petersburg (USA); George Mason Univ., Fairfax, VA (USA); Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 8p. (CONF-8606134—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006904.

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (1 Jun 1986).

Low temperature sites for muons implanted in TiH/sub x/ have been found to be a mixture of interstitial and substitutional sites, with substitutional occupancy determined by the probability that a muon is an interstitial site will have a vacant nearest neighbor substitutional site. As with ZrH/sub x/, activation from the interstitial site is observed below 300°K. From the depolarization rate in the substitutional site, the muon likely displaces the neighboring H atoms by about 0.1 A. Diffusion for the substitutional muons occurs above room temperature with an activation of about 0.38 eV, which is less than the 0.505 eV for hydrogen vacancy motion observed by NMR. To explain this the muon transition rate to a vacancy must be less than that of hydrogen.

22923 (CONF-861019—26) Scanning Auger microanalysis (SAM) studies of carbide coatings of titanium, zirconium and hafnium. Kaufherr, N. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004864.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

This paper reports results of quantitative scanning Auger microanalysis (SAM) studies of Ti, Zr, and Hf carbide coatings on T-15 cutting tool inserts prepared by PVD. (DLC)

22924 (CONF-861185—12) The effect of fabrication variables on the irradiation performance of uranium silicide dispersion fuel plates. Hofman, G.L.; Neimark, L.A.; Olquin, F.L. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006970.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

The effect of fabrication variables on the irradiation behavior of uranium silicide-aluminum dispersion fuel plates is examined. The presence of minor amounts of metallic uranium-silicon was found to have no detrimental effect, so that extensive annealing to remove this phase appears unnecessary. Uniform fuel dispersant loading, low temperature during plate rolling, and cold-worked metallurgical condition of the fuel plates all result in a higher burnup threshold for breakaway swelling in highly-loaded U_3Si fueled plates.

22925 (CONF-861207—89) HREM of grain boundaries in oxides. Merkle, K.L. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006983.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Recent progress in the understanding of the atomic structure of grain boundaries in ionic solids is briefly reviewed with emphasis on the application of the HREM technique to observations of tilt grain boundaries in NiO. The new generation of high-resolution electron microscopes which are capable of a point-to-point resolution of better than 2 A have allowed atomic-scale observations that can be directly compared to theoretical grain boundary models. Agreements and differences between theory and experiment are discussed. The importance and significance of faceting and asymmetrical boundaries is pointed out.

22926 (INIS-mf—10581, pp 13-15) Ion implantation and fracture toughness of ceramics. Clark, J.; Pollock, J.T.A. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Ceramics generally lack toughness which is largely determined by the ceramic surface where stresses likely to cause failure are usually highest. Ion implantation has the capacity to improve the surface fracture toughness of ceramics. Significantly reduced ion size and reactivity restrictions exist compared with traditional methods of surface toughening. We are studying the effect of ion implantation on ceramic fracture toughness using indentation testing as the principal tool of analysis.

22927 (LBL—22696) Surface characterization and manipulation of Si_3N_4 and SiC powders. Boiteux, Y.P. (Lawrence Berkeley Lab., CA (USA)). Dec 1986. Contract AC03-76SF00098. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007168.

A thorough characterization of some commercially available Si_3N_4 and SiC powders is undertaken. Physical characteristics, such as state of agglomeration, particle size, are determined by means of scanning electron microscopy and high voltage electron microscopy. High resolution electron microscopy revealed the existence of a 5 to 15 nm thick amorphous surface layer present on both types of powders. The surface layer chemical composition was determined by secondary ion mass spectrometry and x-ray photoelectron spectroscopy. For Si_3N_4, the data indicate the existence of a range of silicon oxynitrides Si/sub x/N/sub y/O/sub z/. For SiC, the 'oxide layer' has a composition very close to SiO_2. In order to eliminate the surface oxide, two chemical treatments were carried out. Both of them were effective, but the oxide layer was never completely reduced. The HF-treatments caused the formation. This work insists on the need for cleaner processing procedures, since native oxide layers are extremely difficult to eliminate and have damaging effects on either sintering kinetics or high temperature mechanical properties.

22928 (ORNL/M—301) Ceramic Technology Newsletter: No. 13. Kertesz, M.P.; Douglas, D.A. (eds.). (Oak Ridge National Lab., TN (USA)). Oct-Dec 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006447.

This newsletter describes: the department of ceramic engineering at Illinois University, production of silicon nitride, transformation-toughened ceramics, and various activities in this area. (DLC)

22929 Optical and electrical properties of niobium carbide. Allison, C.Y.; Modine, F.A.; French, R.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **35**: No. 6, 2573-2582(15 Feb 1987). Contract AC05-84OR21400.

The optical and electrical properties were measured for single crystals of NbC/sub x/ for x = 0.98, 0.87, and 0.76, and for one hot-isostatically-pressed sample of NbC/sub 0.88/. Specular reflectance was measured between 0.025 and 11 eV, and ellipsometry measurements were made at 1.96 eV. By using the phase obtained from ellipsometry data to correct the Kramers-Kronig analyses of the reflectances, we were able to improve the accuracy of the resulting optical functions. For energies below 6.5 eV, there are differences in the reflectance and optical functions of the samples which are due to differences in x. We interpret the low-energy optical data in terms of intraband transitions, which allows us to calculate the dc conductivity as well as other electronic transport parameters. These parameters agree well with the electrical conductivities and the Hall coefficients obtained by the van der Pauw technique. The higher-energy optical data are interpreted in light of recent electronic-structure calculations, which suggest that most interband transitions occur near the square face of the Brillouin zone.

22930 **Investigation of the electronic structure and phonon anharmonicity in β- and γ-NbH.** Tao, H.h.; Ho, K.h.; Zhu, X.h. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8394-8400(15 Dec 1986). Contract W-7405-ENG-82.

First-principles electronic-structure and total-energy calculations have been performed for NbH in the β- and γ-phase structures. Lattice constants, bulk moduli, and heats of formation have been calculated and found to be in excellent agreement with measured values. We have made detailed "frozen-phonon" calculations investigating the effect of anharmonic couplings on the optical vibrations of hydrogen and its isotopes in NbH.

22931 **Boron hydride polymer coated substrates.** Pearson, R.K.; Bystroff, R.I.; Miller, D.E. (to Dept. of Energy). US Patent Application 6-900,859. 27 Aug 1986. 19p. Contract W-7405-ENG-48. DE87007213 NTIS, PC A02/MF A01; GPO Dep. File Number DE87007213.

A method is disclosed for coating a substrate with a uniformly smooth layer of a boron hydride polymer. The method comprises providing a reaction chamber which contains the substrate and the boron hydride plasma. A boron hydride feed stock is introduced into the chamber simultaneously with the generation of a plasma discharge within the chamber. A boron hydride plasma of ions, electrons and free radicals which is generated by the plasma discharge interacts to form a uniformly smooth boron hydride polymer which is deposited on the substrate.

22932 **Magnetic susceptibility of californium oxides.** Moore, J.R.; Nave, S.E.; Haire, R.G.; Huray, P.G. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

Magnetic susceptibility measurements have been performed on the oxide system of californium. Polycrystalline samples of Cf_2O_3 (cubic and monoclinic), Cf_7O_{12}, CfO_2 and $BaCfO_3$ have been studied at magnetic fields up to 50 kG and temperatures between 4.2 and 340 K. All the oxides exhibit Curie-Weiss behavior above 100 K. In all cases, the paramagnetic effective moments are in reasonable agreement with the free-ion, intermediate-coupling value for the 3+ and 4+ charge states assigned on the basis of the stoichiometry. Antiferromagnetic ordering is observed in all these oxides at temperatures below 20 K. Crystal field effects are evident in the temperature range between about 20 and 100 K.

22933 **Spin-density study of UCl_4 - discovery of covalency effects.** Lander, G.H.; Brown, P.J.; Spirlet, M.R.; Rebizant, J.; Kanellakopulos, B.; Klenze, R. (Institut Max von Laue - Paul Langevin, Grenoble, France; Argonne National Lab., IL; Liege Univ., Belgium; Commission of the European Communities, Karlsruhe, Germany, F.R.; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

Neutron experiments have been performed to measure the induced spin-density distribution in single crystals of uranium tetrachloride at low temperature. A structural refinement has also established the atomic positions and thermal parameters at low temperature and these are in agreement with earlier studies. The spin-density distribution, determined with polarized neutrons, shows small but significant deviations from that expected from the single-ion crystal-field model. Fourier difference maps show a small depletion of the 5f density near the uranium site and a small positive increase of about 1 A from the uranium site and principally along the shorter U-Cl bonds. We ascribe this to population of a 6d (x^2-y^2) orbital. No significant spin density is associated with the chlorine site. Model calculations are presented which qualitatively account for the observed effect and involve electron transfer from the 5f to the 6d antibonding orbital formed as a result of a covalent interaction between the U 6d and Cl p states. This is the first direct observation of covalency in systems involving 5f 6d electrons.

22934 **Magnetic susceptibility of CfN, CfAs and CfSb.** Nave, S.E.; Moore, J.R.; Haire, R.G.; Peterson, J.R.; Damien, D.A.; Huray, P.G. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

Magnetic susceptibility measurements are reported for the compounds CfN, CfAs and CfSb. These semimetallic compounds exhibit the NaCl-type cubic crystal structure. For these magnetic measurements the temperature was varied from 4.2 K to 340 K and the magnetic field from 1 to 50 kG. The paramagnetic effective moments derived from Curie-Weiss fits to the data agree, within experimental error, with a theoretical value of 10.2 μ/sub B/ calculated for the $5f^9$ electronic state of Cf^{3+} assuming an intermediate-coupling model. Deviations of the susceptibility from Curie-Weiss behavior at lower temperatures are indicative of magnetic ordering and crystal-field splitting of the ground state. The ordering temperatures of these californium compounds are considerably lower than those observed previously for pnictides of curium and berkelium. This decrease in ordering temperature with increasing atomic number is consistent with the trend observed for the lanthanide monopnictides.

22935 **Applications of neutron scattering to problems in materials science.** Weertman, J.R. (Northwestern Univ., Evanston, IL). *Materials Research Society Symposia Proceedings;* **41**: 73-82(1985). Contract AC02-81ER10960.

Neutrons possess a number of attributes which make neutron scattering a powerful technique for the investigation of problems in materials science. These properties are discussed with emphasis on their importance to materials characterization. A number of recent experiments using neutron scattering will be described. These studies include the areas of damage accumulation; residual stress; porosity in ceramics; polymer chain configurations; phase changes. 35 references, 7 figures.

22936 **Summary abstract: surface structural determination of UO_2(111) and (100) using Rutherford backscattering).** Thompson, K.A.; Valone, S.M.; Ellis, W.P.; Taylor, T.N.; Maggiore, C.J. (Univ. of California, Los Alamos). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 2, 1005-1006(Apr-Jun 1984). Contract AS05-79ER10427.

Since the (111) face of UO_2 is structurally simpler than the (100) surface, it was examined first and used to determine the appropriate modeling parameters for UO_2. The experimental rocking curve for the U peak near the <110> direction on the (111) face was found to be asymmetric, indicating an outward relaxation of the topmost U surface layer. The previously reported more complicated structure found on the (100) surface has been previously ascribed to the existence of a chain-like oxygen overlayer residing on an undistorted, underlying, bulklike U lattice. This study used Rutherford backscattering and Monte Carlo simulation to demonstrate an outward U surface layer relaxation for the UO_2 (111) surface. 9 references, 1 figure.

3606 Other Materials

REFER ALSO TO CITATION(S) 22302, 22315, 22329, 22362, 22897, 22910, 22912, 22935, 23091, 23092, 23136, 23478, 23479, 23480, 23481, 23482, 24110, 24139

22937 (BMI/ONWI—633) Thermal properties of Permian Basin evaporites to 493 K temperature and 30 MPa confining pressure. Durham, W.B.; Heard, H.C.; Boro, C.O.; Keller, K.T.; Ralph, W.E.; Trimmer, D.A. (Lawrence Livermore National Lab., CA (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1987. Contract AC02-83CH10140. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87007357.

Laboratory measurements of the thermal conductivity and diffusivity of four rock salts, two anhydrites, and two dolomites bordering Cycle 4 and Cycle 5 bedded salt formations in the Permian Basin in Deaf Smith County, Texas, were made in conditions ranging from 303 to 473 K in temperature and 0.1 to 31.0 MPa in hydrostatic confining pressure. Within the +-5% measurement resolution neither conductivity nor diffusivity showed a dependence upon pressure in any of the rocks. Conductivity and diffusivity in all rocks had a negative temperature dependence. For the Cycle 4 salt samples, conductivity fell from 5.5 to 3.75 W/m . K, and diffusivity fell from about 2.7 to 1.7 x 10^{-6} m^2/s. One Cycle 5 salt was a single crystal with anomalous results, but the other had a low conductivity with very weak temperature dependence and a high diffusivity. In the nonsalts, conductivity and diffusivity decreased 10 to 20% over the temperature range explored. In measurements of the coefficient of thermal linear expansion for Cycle 5 salt and nonsalts, the coefficient typically varied from about 12 x 10^{-6} K^{-1} at P = 3.0 MPa to 4 x 10^{-6} K^{-1} at P = 30 MPa for both nonsalt rocks. In anhydrite, it decreased with increasing temperature. In dolomite, the coefficient increased at roughly the same rate. Expansion of the salt ranged from 33 to 38 x 10^{-6} K^{-1} and was independent of pressure and temperature.

22938 (CONF-861207—77) Scattering studies on mixtures of poly(ethylene oxide) with poly(methyl methacrylate). Russell, T.P.; Ito, H.; Wignall, G.D. (IBM Almaden Research Center, San Jose, CA (USA); Oak Ridge National Lab., TN (USA)). 1 Dec 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006616.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Molten and semi-crystalline mixtures of PEO and PMMA have been investigated by small angle neutron and x-ray scattering. It has been found that the Flory Huggins interaction parameter, evaluated from the intermolecular scattering function, is quite small and is apparently dominated by entropic contributions. Scattering profiles from the semi-crystalline mixtures clearly show that the PMMA is incorporated within the amorphous phase between the crystalline PEO lamellae.

22939 (CONF-861207—79) Neutron scattering from charged polymer lattices. Hayter, J.B. (Oak Ridge National Lab., TN (USA)). 2 Dec 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006628.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Aqueous suspensions of charged polymer latex particles exhibit several forms of ordered structure, the particular form depending on the size, number density and charge of the latex particles, and on the ionic strength of the aqueous medium. At low ionic strength, the inter-particle potential may become sufficiently long-ranged to generate crystalline order, which usually shows bcc symmetry at low density and becomes fcc above about 3% volume fraction of latex in the system. As the ionic strength increases, the crystalline structure melts, and ordered liquid structures develop. This paper reviews some of the recent small-angle neutron scattering experiments on polymer latex suspensions, in the light of new theoretical methods which permit in situ analysis of the particle size and charge. The discussion also encompasses new experimental methods for studying latex structures under dynamic shear conditions.

22940 (CONF-861207—84) Transport and reaction kinetics at the glass:solution interface region: Results of repository-oriented leaching experiments. Abrajano, T.A. Jr.; Bates, J.K. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006975.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Repository-oriented leaching experiments involving Savannah River Laboratory (SRL) 165 type glass under a γ-radiation field (1 = 0.2 x 10^4 R/h) have been performed by the Nevada Nuclear Waste Storage Investigations (NNWSI) project. In this communication, we discuss glass surface analyses obtained by SEM, nuclear resonance profiling, and SIMS together with leachate solution data in relation to a mechanism that couples diffusion, hydrolysis (etching and gelation), and precipitation to qualitatively describe the release of different glass components to the leachant solutions. The release of mobile (e.g., Li) and partly mobile (e.g., B) species is controlled primarily by interdiffusion with water species across the interdiffusion zone. Glass components that are immobile in the interdiffusion zone are released to the solution by etching. For prediction of long-term steady-state concentrations of glass components with low solubility, the relative rates of release from the glass and secondary mineral precipitation must be taken into account.

22941 (CONF-861207—88) Molecular-dynamics simulation of thin-film growth. Schneider, M.; Schuller, I.K.; Rahman, A. (Argonne National Lab., IL (USA); Minnesota Univ., Minneapolis (USA). Supercomputer Inst.). Jan 1987. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006973.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The epitaxial growth of thin films has been studied by molecular-dynamics computer simulation. In these simulations atoms are projected towards a temperature-controlled substrate, and the equations of motion of all atoms are solved for a given interaction potential. The calculations give insight into the microscopic structure of thin films, the dynamics of the adsorption process, and they help answer the way in which substrate temperature, form of the substrate, flux of impinging atoms, and form of the interaction potential, affect epitaxial growth. Simulations were performed for monatomic and binary systems with spherically symmetric atomic interactions, and for systems in which the atoms are interacting via a three-body potential to simulate the epitaxial growth of silicon.

22942 (DOE/ER/45123—3) Fundamental studies of elastomers: Progress report, June 15, 1984-June 14, 1987. Eichinger, B.E. (Washington Univ., Seattle (USA). Dept. of Chemistry). 15 Feb 1987. Contract FG06-84ER45123. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007119.

Work reported include: synthesis of metal-chelate elastomers, derivation of diene polymers, preparation of coordination polymers, electric conductivity, computer simulations, and theoretical shapes.

22943 (DOE/ER/45185—T1) The workshop on conductive polymers: Final report. (Polytechnic Univ., Brooklyn, NY (USA). Polymer Research Inst.). 1985. Contract FG02-85ER45185. 61p. NTIS, PC A04. File Number DE87006299.

Reports are made by groups on: polyacetylene, polyphenylene, polyaniline, and related systems; molecular, crystallographic, and defect structures in conducting polymers; heterocyclic polymers; synthesis of new and improved conducting polymers; future applications possibilities for conducting polymers; and challenges for improved understanding of properties. (DLC)

22944 (IA—1421, pp 103) Use of DCD for structural properties characterization of substrates and layers of II-VI compounds. Raizman, A.; Shaham, H. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

22945 (IA—1421, pp 105) **Neodymium ion distribution in Nd YAG crystals.** Shimony, Y.; Biderman, S.; Goldbart, Z.; Laor, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22946 (INIS-mf—10581, pp 1-6) **Ion beam induced epitaxial crystallization of amorphous silicon.** Elliman, R.G.; Williams, J.S.; Brown, W.L. (Commonwealth Scientific and Industrial Research Organization, Clayton, Australia. Div. of Chemical Physics; Royal Melbourne Inst. of Tech., Australia; AT and T, Inc., Princeton, NJ, USA). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

MeV Ne/sup +/ ion bombardment has been employed to promote solid phase epitaxial growth (SPEG) of amorphous silicon layers at temperatures between 200-500 deg C. For temperatures less than 400 deg C, growth on (100) orientated substrates is observed to be linearly dependent on ion fluence and exhibits a thermal activation energy of 0.24 eV. At temperatures above 400 deg C, growth is non-linear with ion fluence, presumably due to competing thermally induced growth processes. These and other results presented in this paper, support a model for ion beam induced SPEG in which growth is nucleated by beam induced defects. This nucleation step is therefore envisaged to be athermal, with subsequent crystallization accounting for the observed activation energy of 0.24 eV. This leads to the speculation that nucleation is the limiting step for thermally induced epitaxy (2.7 eV activation energy), and implies that the activation energy for nucleation in this case is 2.4 eV.

22947 (INIS-mf—10581, pp 7-12) **Ion beam applications in semiconductor materials.** Johnson, S.T. (Royal Melbourne Inst. of Tech., Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The semiconductor industry relies heavily on ion-beam techniques for both the introduction of impurities into substrates (ion implantation) and for the analysis of the layers so formed. Ion beam techniques also play an important role in the analysis of various thin film and surface reactions that can occur during device processing. This review concentrates mainly on Rutherford Backscattering Spectrometry and ion channeling which are the most frequently used techniques for characterising semiconductors.

22948 (INIS-mf—10581, pp 16-18) **Rapid thermal annealing of phosphorus implanted silicon.** Lee, Y.H.; Pogany, A.; Harrison, H.B.; Williams, J.S. (Royal Melbourne Inst. of Tech., Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Rapid thermal annealing (RTA) of phosphorus-implanted silicon has been investigated by four point probe, Van der Pauw methods and transmission electron microscopy. The results have been compared to furnace annealing. Experiments show that RTA, even at temperatures as low as 605 deg C, results in good electrical properties with little remnant damage and compares favourably with furnace annealing.

22949 (INIS-mf—10589, pp 331-332) **Anomalies of Si Pn-junctions after fast neutron irradiation.** Mackova, V.; Ballo, P.; Macko, P.; Lacko, T. (Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Elektrotechnicka Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

22950 (INIS-mf—10589, pp 333-334) **Properties of Si diodes after fast neutron irradiation.** Macko, P.; Ballo, P.; Lacko, T.; Mackova, V.; Mudron, J. (Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Elektrotechnicka Fakulta; Vysoka Vojenska Technicka Skola, Liptovsky Mikulas, Czechoslovakia. Katedra Fyziky). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

22951 **(Juel—2052) Kinetics of the graphite/oxygen reaction in the in-pore diffusion controlled regime. Pt. 2. Graphites V483T, ASR-1RS, ASR-1RG and ATR-2E.** Hinssen, H.K.; Katscher, W.; Moormann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Apr 1986. 69p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751322.

In connection with analyses of severe air ingress accidents in high temperature gas-cooled reactors, in a previous work kinetic data on the reaction between oxygen and graphitic fuel element matrix materials in the inpore diffusion controlled regime have been presented. Supplementary to this the present report in the same field of parameters such as temperatures (approx. 950-1200 K corresponds to approx. 680-930/sup 0/C), gas pressure (1,5 bar constant with helium as the carrier gas) and oxygen partial pressures (0,015 to 0,15 bar) deals with the kinetics of the reaction of the graphites ASR-1RS, ASR-1RG, V483T and ATR-2E with oxygen. As a result these graphites - also in comparison with the matrix materials - show comparatively small differences in their reactivities with ASR-1RS having the lowest, ATR-2E the highest reactivity. The experiments in oxygen containing helium hereby have been completed.

22952 **(Juel-Spez—359) Fracture criterion for brittle materials based on statistical cells of finite volume.** Cords, H.; Kleist, G.; Zimmermann, R.; Kraus, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Jun 1986. 124p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751216.

An analytical consideration of the Weibull Statistical Analysis of brittle materials established the necessity of including one additional material constant for a more comprehensive description of the failure behaviour. The Weibull analysis is restricted to infinitesimal volume elements in consequence of the differential calculus applied. It was found that infinitesimally small elements are in conflict with the basic statistical assumption and that the differential calculus is not needed in fact since nowadays most of the stress analyses are based on finite element calculations, and these are most suitable for a subsequent statistical analysis of strength. The size of a finite statistical cell has been introduced as the third material parameter. It should represent the minimum volume containing all statistical features of the material such as distribution of pores, flaws and grains. The new approach also contains a unique treatment of failure under multiaxial stresses. The quantity responsible for failure under multiaxial stresses is introduced as a modified strain energy. Sixteen different tensile specimens including CT-specimens have been investigated experimentally and analyzed with the probabilistic fracture criterion. As a result it can be stated that the failure rates of all types of specimens made from three different grades of graphite are predictable. The accuracy of the prediction is one standard deviation.

22953 **(LBL-PUB—606) Semiconductor research capabilities at the Lawrence Berkeley Laboratory.** (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006931.

This document discusses semiconductor research capabilities (advanced materials, processing, packaging) and national user facilities (electron microscopy, heavy-ion accelerators, advanced light source). (DLC)

22954 **(PB—87-130761/XAB) AlGaAs laser diodes grown by MOCVD.** Ikeda, K.; Mihashi, Y.; Kaneno, N.; Isshiki, K.; Yamashita, K. (Mitsubishi Electric Corp., Tokyo (Japan)). 1986. 5p. NTIS, PC PC E04/MF E01.

Included in Mitsubishi Denki Giho, Vol. 60, No. 8, 32-35(1986).

The Corporation has developed two new laser diodes using metal organic chemical vapor deposition (MOCVD), a technique that yields excellent uniformity and is highly suited to mass production. One of the new LDs is a 0.89 micrometer-band crank TJS (transverse junction stripe) type, and the other, a 0.78 micrometer-band SBA (self-aligned structure with bent active layer) type. The TJS laser achieves the same excellent characteristics and long life of identical LDs produced by liquid-phase epitaxy (LPE), with improved uniformity of characteristics. The SBA laser diode offers similar characteristics with the small astigmatism (less than 2 micrometers) and improved noise characteristics required for applications in optical-disk systems.

22955 **(PB—87-130779/XAB) AlGaAs laser diodes grown by molecular-beam epitaxy.** Mitsunaga, K.; Ota, J.; Kojima, K.; Noda, S.; Kyuma, K. (Mitsubishi Electric Corp., Tokyo (Japan)). 1986. 5p. NTIS, PC PC E04/MF E01.

Included in Mitsubishi Denki Giho, Vol. 60, No. 8, 36-39(1986).

The article reports on the characteristics of a III approximately V group compound AlGaAs semiconductor laser diode produced by molecular-beam epitaxy (MBE). TJS and ridge-type DFB lasers are introduced as examples of the high crystal quality and excellent growth control that can be achieved by MBE techniques. These advances suggest that MBE will be suitable for producing the integrated opto-electronic circuits needed to realize high-performance multifunction laser diodes.

22956 **(PNL—6069) Evaluation of wear rates and mechanisms of titanium diboride-graphite composite materials proposed for use as cathodes in Hall-Heroult cells.** Pool, K.H.; Brimhall, J.L.; Raney, P.J.; Hart, P.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007156.

Purpose of this study was to measure the initial wear rates of TiB_2 carbon-containing cathode materials (TiB_2-G) under electrolytic conditions. Parameters evaluated included bath ratio, current density, and aluminum pad thickness. In order to measure initial wear rates, the tests were limited to 8 h.

22957 **(SAND—86-1374C) Atomistic calculation of stability and metastability of coherently strained silicon-like structures.** Dodson, B.W.; Taylor, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 12p. (CONF-861207—75). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002049.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Monte Carlo based microscopic techniques were used to study the stability and metastability of thin coherently strained layers of mismatched silicon-like semiconductor material grown on the (111) silicon surface. The structural energy was calculated using three-body empirical potentials. For layers greater than about 20 A thickness, the critical layer thickness associated with thermodynamic stability is accurately described by the continuum theory of Matthews and Blakeslee. For thinner layers, however, the stability properties vary considerably from those predicted by the continuum theory. The test system is found to be metastable against the nucleation of misfit dislocations to a lattice mismatch of about 11% for a strained layer six monolayers thick, compared to the 4% mismatch stability limit.

22958 **(SAND—86-2213C) Atomistic simulation of stability properties and growth of strained layer structures.** Taylor, P.A.; Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-870385—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006712.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (22 Mar 1987).

Monte Carlo based microscopic techniques were used to study the stability and metastability of thin coherently strained layers of mismatched silicon-like semiconductor material grown on the (111) silicon surface. The structural energy was calculated using three-body empirical potentials. For layers greater than roughly 20 A in thickness, the critical layer thickness associated with thermodynamic stability agrees quantitatively with continuum theory. For thinner layers, however, considerable variations from the continuum theory are found. For a strained layer six monolayers thick, the test system is found to be metastable against the nucleation of misfit dislocations to a lattice mismatch of approximately 11%, compared to the 4% equilibrium stability limit. Additionally, simulation of strained layer growth of two-dimensional Lennard-Jones crystal lattices has been performed using molecular dynamics. In particular, we have studied the influences of lattice mismatch and substrate temperature on the growth, from the vapor phase, of overlayer material possessing a different bulk lattice constant than that of the substrate material. Simulation results predict that at substrate temperatures less than 50% of melting, epitaxial growth occurs for mismatch values less than 4% whereas above this value, defective growth is observed. At temperatures above 50% of the melt temperature, mass transport occurs across the layer interface and rapid diffusion is observed in the top-most atomic layers, resulting in liquid-like behavior in a thin layer over ordered strained layer crystal.

22959 **(SAND—86-2555C) A statistical study of the combined effects of substrate temperature, bias, annealing, and a Cr_3Si_2 undercoating on the tribological properties of rf-sputtered MoS_2 coatings.** Panitz, J.K.G.; Pope, L.E.; Hills, C.R.; Lyons, J.E.; Staley, D.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-870388—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007086.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

We have completed a study of the effects of (1) substrate temperature, (2) substrate bias, (3) post-deposition annealing, and (4) the presence of a Cr_3Si_2 undercoating on the tribological properties of 300 to 500 nm thick MoS_2 coatings which were rf-sputter deposited on annealed 304 stainless steel substrates. It was determined that a Cr_3Si_2 undercoating and substrate bias are the most important individual factors in order to obtain MoS_2 coatings with low coefficients of friction, 0.07. The highest coefficients of friction, 0.12, occurred for coatings which were not heated during deposition nor annealed afterwards and which were deposited onto substrates that were not biased during deposition or precoated with Cr_3Si_2. Coatings which were deposited onto substrates that were precoated with Cr_3Si_2, subjected to deposition temperatures of 300°C, biased during deposition and annealed afterwards were able to withstand the most wear. The best MoS_2 coatings with regards to both coefficient of friction and wear occur over a broad range of substrate biases from -50 to -100 V. Transmission electron microscopy indicates that there are significant differences in the morphology of the MoS_2 coatings which occur in conjunction with the different deposition conditions studied.

22960 **(SAND—86-2724C) Growth and characterization of GaAs/AlAs superlattice alloys.** Drummond, T.J.; Jones, E.D.; Hjalmarson, H.P.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 24p. (CONF-870385—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006891.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (22 Mar 1987).

The superlattice bandstructure of short-period GaAs/AlAs superlattices grown by molecular beam epitaxy resembles that of the AlGaAs alloy system. We have studied indirect gap GaAs/AlAs superlattice alloys using x-ray diffraction and pressure dependent magneto-luminescence. Analysis of the x-ray data shows that the AlAs layers are strained to be pseudomorphic with the GaAs substrate. Because the indirect conduction band ground state derives from the AlAs X-point these superlattice alloys must be treated as strained-layer superlattices. Interpretation of luminescence data using Kronig-Penney and tight-binding analyses of the superlattice bandstructure and optical dipole matrix elements shows

that this experiment provides a sensitive measure of the conduction band offset for the GaAs/AlAs system. Quantum size effects lift the three-fold degeneracy of the X-point to yield an in-plane X band quantized according to the transverse electron mass (X/sub t/) and a separate X band along the superlattice axis quantized according to the longitudinal electron mass (X_l). Strain shifts at the X-points are of the same magnitude as quantum size effect shifts and drive the X/sub t/ band toward lower energies. The effect of strain in the conduction band can be accurately modeled by assuming GaP deformation potentials for the AlAs layers.

22961 **(SAND—87-0326C) Aging studies of elastomers using a modulus profiling apparatus.** Gillen, K.T.; Clough, R.L.; Quintana, C.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-870482—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87007024.

From 14. Department of Energy compatibility, aging and service life conference; Amarillo, TX, USA (28 Apr 1987).

An apparatus has been developed which allows one to easily obtain >20 tensile compliance measurements per mm of sample cross section. Modulus profiles are shown for radiation-aged viton and 120°C-aged nitrile rubber. (DLC)

22962 **(SAND—87-0437C) Bandgap energy pressure coefficients in strained-layer structures.** Jones, E.D.; Fritz, I.J.; Hjalmarson, H.P.; Schirber, J.E.; Smith, M.C.; Biefeld, R.M.; Dawson, L.R.; Drummond, T.J. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 16p. (CONF-870385—2). NTIS MF A01; 2; GPO Dep File Number DE87006713.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (22 Mar 1987).

The hydrostatic-pressure coefficients of the bandgap energies for four different types of semiconductor heterojunction structures were obtained from photoluminescence measurements at 4K and pressures up to 4 kbar. The structures studied were n-type and p-type In/sub x/Ga/sub 1-x/As/GaAs and n-type GaAs/GaP/sub x/As/sub 1-x/ strained-layer superlattices, n-type In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells and an undoped GaAs/AlAs superlattice. The bandgap energies ranged from 1800 MeV for the GaAs/AlAS structure to 1280 MeV for the In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells. Pressure coefficients for the In/sub x/Ga/sub 1-x/As/GaAs and GaAs/GaP/sub x/As sub 1-x/ structures were found to be in the range of 10 to 12 MeV/kbar. However, the pressure coefficient of the luminescence energy from the GaAs/AlAs superlattice was found to be -2 MeV/kbar. This negative pressure coefficient is consistent with the interpretation that the luminescence is due to a transition between the construction-band X-point in the AlAs layers and the valence-band Γ-point in the GaAs layers.

22963 **Two-photon-absorption cross section of Nd/sup 3+/ in yttrium aluminum garnet and yttrium lithium fluoride near 1.06 μm.** Chase, L.L.; Payne, S.A. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8883-8891(15 Dec 1986). Contract W-7405-ENG-48.

We have measured the spectrally integrated two-photon-absorption (TPA) cross sections for the ^{4}I/sub 9/2/→ ^{4}G/sub 7/2/ transitions of Nd/sup 3+/ and obtained values of 1.2 x 10/sup -40/ and 0.15 x 10/sup -40/ cm^4 for Nd/sup 3+/-doped yttrium aluminum garnet (YAG) and yttrium lithium fluoride (YLF), respectively. These results are in satisfactory agreement with theoretical calculations based on the properties of Nd/sup 3+/ free-ion wave functions. The difference between YAG and YLF, however, is not accounted for by the free-ion theory and suggests that the intermediate-state energies and wave functions are considerably host dependent. In addition, we conclude, based on our measurements, that rare-earth TPA will not contribute significantly to either losses or the nonlinear refractive index in typical laser media employing rare-earth ions.

22964 **Energy spectra of donors and acceptors in quantum-well structures: Effect of spatially dependent screening.** Oliveira, L.E.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720 Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8676-8683(15 Dec 1986).

The energy spectra of shallow donors and acceptors in GaAs-Ga/sub 1-//sub x/Al/sub x/As quantum-well structures have been calculated. The binding energies of the impurities were obtained within a variational calculation in the effective-mass approximation. Calculations were performed for simple neutral and double singly ionized impurities as functions of the position of the impurity in a GaAs quantum well of infinite depth and for various slab thicknesses. The effect of the spatially dependent screening is modeled with a dielectric response of the form ϵ/sup -1/(r) = ϵ_0/sup -1/ +(1-ϵ_0 /sup -1/)e/sup -r/a/, with a screening parameter a≅1.1 a.u. characteristic of bulk GaAs. Results are compared with Bastard's theory, which is based on a constant-ϵ_0 screening, and it is found that spatially dependent screening effects are small for donors down to very thin slab thicknesses, but can be quite important for all acceptors in GaAs quantum wells over a large range of slab thicknesses. Calculated results with improved statistics are in quantitative agreement with experimental data on neutral donors and acceptors.

22965 **Energy transfer among Yb/sup 3+/ ions in a silicate glass.** Brundage, R.T.; Yen, W.M. (University of Wisconsin Madison, Madison, Wisconsin 53706). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 8810-8814(15 Dec 1986).

We have used time-resolved fluorescence line narrowing to study energy transfer among Yb/sup 3+/ ions in a silicate glass as a function of energy mismatch between donors and acceptors and temperature from 4.2 to 51 K. The observed spectra are consistent with a one-phonon-assisted multipolar interaction between Yb/sup 3+/ ions with a variation with site separation of r/sup -13/. These results are compared to that reported for other rare-earth-ion transitions in glasses and crystals.

22966 **Contamination-mediated deformation of graphite by the scanning tunneling microscope.** Mamin, H.J.; Ganz, E.; Abraham, D.W.; Thomson, R.E.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720 and Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **34**: No. 12, 9015-9018(15 Dec 1986).

We demonstrate that surface deformation mediated by contamination plays a major role in images of graphite obtained by a scanning tunneling microscope in air. Atomic resolution has been obtained with the surface compressed by as much as 100 A, where abnormally high atomic corrugations, up to 24 A, are observed. Calculation of the deformation profile reveals that the force necessary to deform the surface must be spread over several thousand square angstroms. The measured deformation is negligible in vacuum with a clean sample and tip, and the corrugation is 0.9 A.

22967 **Molecular dissociation and shock-induced cooling in fluid nitrogen at high densities and temperatures.** Radousky, H.B.; Nellis, W.J.; Ross, M.; Hamilton, D.C.; Mitchell, A.C. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* **57**: No. 19, 2419-2422(10 Nov 1986). Contract W-7405-ENG-48.

Radiative temperatures and electrical conductivities were measured for fluid nitrogen compressed dynamically to pressures of 18—90 GPa (180—900 kbar), temperatures of 4000—14000 K, and densities of 2—3 g/cm^3. The data show a continuous phase transition above 30 GPa shock pressure and confirm that (partialP/partialT)/sub v/<0, as indicated previously by Hugoniot equation-of-state experiments. The first observation of shock-induced cooling is also reported. The data are interpreted in terms of molecular disso-

ciation and the concentration of dissociated molecules is calculated as a function of density and temperature.

22968 Isotope effects on interdiffusion in blends of normal and deuterated polymers. Green, P.F.; Doyle, B.L. (Sandia National Laboratory, Albuquerque, New Mexico 87185-5800). *Physical Review Letters;* **57**: No. 19, 2407-2410(10 Nov 1986). Contract AC04-76DP00789.

"Thermodynamic slowing down" effects on interdiffusion are demonstrated in binary mixtures of normal and deuterated polystyrene. The interdiffusion coefficient is shown to undergo a minimum in the vicinity of a critical blend composition Phi/sub c/. This effect increases with decreasing temperature.

22969 Hybridization between 4f and conduction electrons and saturation of mixed valence in cerium-based systems. Raaen, S.; Parks, R.D. (Polytechnic Institute of New York, Brooklyn). *Physical Review* [*Section*] *B: Condensed Matter;* **32**: No. 6, 4241-4244(15 Sep 1985). Contract AC02-81ER10862;FG02-85ER45195.

The increase in 4f-conduction-electron hybridization, as determined from deep-core photoemission studies, is compared with the increase in the mixed valence across the archetypal, continuously valence-variable system Ce(Pd/sub 1-x/T/sub x/)$_3$, where T = Ag or Rh. No anomaly is observed in the hybridization near x/sub Rh/ = 0.2, where the mixed valence rather abruptly saturates. Instead, a linear relationship is found between the f-d hybridization and the volume of the unit cell. This finding is consistent with a recent model which explains the valence saturation in terms of thermodynamics. 12 references, 5 figures.

22970 Simplified electrostatic model for band-gap underestimates in the local-density approximation. Carlsson, A.E. (Washington Univ., St. Louis, MO). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 8, 5178-5182(15 Apr 1985). Contract FG02-84ER45130.

An estimate of the undercounted electrostatic energy terms in local-density-functional total-energy calculations for nonmetallic systems with separated electron-hole pairs is used to derive a simplified correction to density-functional - theory band gaps. The correction is evaluated for Ne, Ar, Kr, LiF, NaCl, CsCl, MgO, CaS, BaS, C, AlP, and Si. The band-gap errors are reduced from 40-50% to 10-15% for most of the systems studied. Conduction-band corrections are shown to be nearly as large as valence-band corrections in free-electron-like semiconductors. 28 references, 1 figure.

22971 Valence state of Ce and the magnetism in $CeRh_3B_2$. Malik, S.K.; Umarji, A.M.; Shenoy, G.K.; Montano, P.A.; Reeves, M.E. (Argonne National Lab., IL). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 7, 4728-4731(1 Apr 1985). Contract AC02-76ER01198.

The compound $CeRh_3B_2$ orders magnetically with a high Curie temperature (T/sub C/) of 115 K but with a low moment of only 0.4 μ/sub B/. L/sub III/ absorption-edge measurements show a dominant absorption peak at the energy corresponding to trivalent cerium. Magnetic studies on the compounds Ce(Rh/sub 1-x/T/sub x/)$_3B_2$ with T = Ru and Os reveal that the magnetic state is very rapidly broken up with the replacement of Rh by Ru and Os. These results, along with the observation of a high T/sub C/ in $CeRh_3B_2$, suggest that magnetism in this compound arises from a strong hybridization of nearly localized or slightly delocalized Ce 4f electrons with conduction electrons. The small moment may be due to a Kondo-type interaction coupled with crystal-field effects. 14 references, 4 figures.

22972 Neutron scattering study of the effect of a random field on the three-dimensional dilute Ising antiferromagnet Fe/sub 0.6/Zn/sub 0.4/F_2. Yoshizawa, H.; Cowley, R.A.; Shirane, G. (Brookhaven National Lab., Upton, NY). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 7, 4548-4556(1 Apr 1985). Contract AC02-76CH00016.

The authors report a comprehensive neutron scattering study of random-field effects in the three-dimensional Ising antiferromagnet Fe/sub 0.6/Zn/sub 0.4/F_2. The sample is the same one used in high-precision birefringence studies. The scattering is dependent on the prior history of the sample at all temperatures below a well-defined temperature which agrees with the phase boundary reported in the birefringence studies to within 0.2 K. When the sample is cooled in a field (FC), long-range order is not established and the scattering has a Lorentzian-squared profile with a width $K \approx H^2$. On the other hand, when the sample is cooled in zero field into the Neel state, the field raised and the temperature then increased (ZFC), the scattering close to the phase boundary consists of an antiferromagnetic Bragg component superimposed on scattering which is characteristic of the FC procedure. The Bragg component is absent when the crystal is heated above the phase boundary. In addition, if after field cooling the system is heated, the width of the scattering is unchanged until the phase boundary is reached. None of the existing $d_1 = 2$ low-temperature theories explains such behavior in the vicinity of the phase boundary. Above the phase boundary ZFC and FC results agree, indicating that the system is always in equilibrium. The authors have studied the critical behavior in this region and the scattering is very different from that with H = 0. Specifically, the scattering profiles show a large Lorentzian-squared component and over a limited temperature range the inverse correlation length varies linearly with temperature. 21 references, 14 figures.

22973 Concentration profile of a dissolved polymer near the air-liquid interface: x-ray fluorescence study. Bloch, J.M.; Sansone, M.; Rondelez, F.; Peiffer, D.G.; Pincus, P.; Kim, M.W.; Eisenberger, P.M. (Brookhaven National Lab., Upton, NY). *Physical Review Letters;* **54**: No. 10, 1039-1042(11 Mar 1985).

The x-ray fluorescence, at the near-total external reflection configuration, was employed to study the concentration profile of a dissolved polymer near the liquid-gas interface. The determine experimental concentration profile conformed with a hyperbolic cotangent squared dependence with a concentration excess ratio of about 100:1 of the surface relative to the bulk. This experiment presents of first direct measurement of that kind at the air-liquid interface and demonstrates the effectiveness of this new method to study nondestructively interface structures on the scale of tens to hundreds of angstroms. 17 references, 3 figures.

22974 Effect of c-axis dispersion on the optical properties of acceptor-type graphite intercalation compounds. Hoffman, D.M.; Eklund, P.C.; Heinz, R.E.; Hawrylak, P.; Subbaswamy, K.R. (Univ. of Kentucky, Lexington). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 4, vp(15 Feb 1985). Contract FG05-84ER45151.

The c-face optical reflectance spectra of stage-1 graphite-$SbCl_5$ and graphite-ICl and stage-2 graphite-$SbCl_5$ have been measured in the photon energy range 0.08 to 10 eV. From a Kramers-Kronig analysis of the spectra, the interband contribution to the imaginary part of the dielectric function epsilon$_2$(omega) has been determined. It is found that a two-dimensional (2D) band-structure model, while describing qualitatively the spectral features below ~ 3 eV, requires the use of an effective temperature much greater than the experimental temperature to explain the width of the onset for valence- to conduction-band absorption in the (stage-1 and -2) compounds. The width of a spectral feature associated with valence- to valence-band absorption in the stage-2 compounds is also not explained satisfactorily by the 2D model. It is shown that weak c-axis dispersion provides a natural explanation for the widths of both of these features. 20 references, 8 figures.

22975 Electric-field-induced new features in the photoconductivity of extrinsic silicon. Chandrasekhar, H.R.; Chandrasekhar, M.; Bajaj, K.K.; Sclar, N. (Univ. of Missouri, Columbia). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 4, 2494-2496(15 Feb 1985). Contract AC02-84ER45048.

Under low background radiation and at low temperatures (~ 1.4 K) the extrinsic photoresponse of phosphorus- and antimony-doped silicon exhibits a peak below the ionization energy of the impurity, when an electric field is applied. This peak grows in intensity and shifts (up to 2 meV) to lower energies as the electric field is increased. Both the position and the intensity of the peak saturate at a critical field which depends inversely on the impurity

concentration. A possible explanation of the observed features is proposed. 6 references, 4 figures.

22976 **Resonant interactions of phonons with donor continuum states in silicon.** Chandrasekhar, H.R.; Chandrasekhar, M.; Bajaj, K.K.; Sclar, N. (Univ. of Missouri, Columbia). *Solid State Communications;* **54**: No. 3, 287-289(1985). Contract AC02-84ER45048.

A study of the extrinsic photoconductivity spectra of phosphorus and antimony donors in silicon at 1.5°K has revealed antiresonances (dips) in the continuum photo response. These dips occur at 380, 437, 479, and 504 cm^{-1} for both donors. The authors interpret these dips as due to a resonant interaction of the donor continuum states with the discrete phonon states. Analogous interaction of the zone center optical phonon at 520 cm^{-1} with the acceptor continuum state of boron as observed by Watkins et al. is not present in the authors spectra. This is attributed to the mismatch of the wave vector and the energy of the 520 cm^{-1} photon with the conduction band minima along <100> directions. The specific phonons giving rise to anti-resonances in their data are identified. 7 references, 1 figure, 1 table.

22977 **Crystal structure of undoped and lithium-doped polyparaphenylene.** Stamm, M.; Fink, J.; Tieke, B. (Kernforschungsanlage Juelich, West Germany). *Molecular Crystals and Liquid Crystals;* **118**: 281-286(1985).

The crystal structure of pristine and Li-doped polyparaphenylene (PPP) has been investigated by electron diffraction. The chain setting angle of pristine PPP has been refined to Phi = 45°. For Li-doped PPP, a superposition of amorphous and crystalline scattering is observed. A simple intercalation model for the crystalline component is in good agreement with the experimental data. 13 references, 2 figures.

22978 **Optical properties of pyrolytic boron nitride in the energy range 0.05-10 eV.** Hoffman, D.M.; Doll, G.L.; Eklund, P.C. (Univ. of Kentucky, Lexington). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 6051-6056(15 Nov 1984). Contract FG05-84ER45151.

Optical reflectance studies of the c face of pyrolytic boron nitride were carried out at room temperature in the photon energy range 0.045-10 eV. A Kramers-Kronig analysis was performed to determine the in-plane real ($epsilon_1$) and imaginary ($epsilon_2$) dielectric functions. Infrared-active transverse-optic phonons were observed at 770 and 1383 cm^{-1}. Strong impurity- and defect-associated absorption was observed throughout the visible and near-ultraviolet region (1-5 eV) which masks, to some extent, the threshold for absorption across the electronic energy band gap. From $epsilon_2$(omega) and the absorption coefficient the authors estimate the direct band gap between π bands to be 5.2 +/- 0.2 eV. Interband transitions associated with high joint density of states were observed at 6.10 and 6.85 eV. The structure in $epsilon_2$(omega) at energies h omega > 5 eV is identified with specific transitions predicted by previous energy-band calculations. 34 references, 6 figures, 2 tables.

22979 **Adjusted valence force field (AVFF) for polyatomic molecules.** Maroni, V.A. (Argonne National Lab., IL). *Spectrochimica Acta, Part A: Molecular Spectroscopy;* **40A**: No. 4, 379-382(1984). Contract W-31-109-ENG-38.

An empirical adjustment concept for valence force-type potential energy functions, called the adjusted valence force field (AVFF), is discussed. In this concept, bond-bond, bond-angle and angle-angle interactions about a given nonterminal atom are correlated with the corresponding principal valence force constants through a single weighting factor. Results obtained using the AVFF have been found to compare favorably with those derived using other types of vibrational potential energy functions. The application of the AVFF to selected gaseous tetrahedral MX_4 molecules is presented as a case in point. 8 references, 2 figures.

22980 **Quenched-in deep acceptors in germanium.** Pearton, S.J.; Haller, E.E.; Kahn, J.M. (Lawrence Berkeley Lab., CA). *Journal of Physics C: Solid State Physics;* **17**: 2375-2379(1984). Contract AC03-76SF00098.

Quenching from temperatures in the range 500-750°C of high-purity p-type germanium induces a deep hole trapping state at E/sub v/ + 0.23 eV. This level is also seen in γ-irradiated samples from the same material, and is tentatively identified as an oxygen-vacancy complex. Quenching from 700°C of copper-doped germanium induces the normal Cu^-, Cu^{2-} and Cu-H levels, as well as a deep hole trap at E/sub v/ + 0.41 eV. Field-assisted emission measurements are consistent with this level being due to triply ionized copper. 12 references, 3 figures.

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REFER ALSO TO CITATION(S) 24143

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 22145, 22224, 22236, 22237, 22242, 22612, 22935, 23104, 23154, 23154, 23178, 23353, 23526, 23721, 23722

22981 **(ATOMKI-C—2(1986)) Determination of gold accumulation in human tissues caused by gold therapy using x-ray fluorescence analysis.** (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Aug 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701443.

Human autopsy tissues from five patients with rheumatoid arthritis treated earlier with aqueous solution of gold and those from untreated control with the same disease were analyzed by x-ray fluorescence spectrometry using a conventional Si(Li) detection system. The gold and zinc concentrations of tissues were determined and compared with literature data. Correlation was found between Zn and Au concentrations in heart, lung, kidney and liver tissues. 12 refs.; 9 figs.

22982 **(ATOMKI-E—25(1986)) Track detection methods of radium measurements.** (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete). Jun 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701444.

The principles of tack formation and processing including the description of etching and etch-track evaluation for the preferably used plastic track detectors are discussed. Measuring methods to determine /sup 226/Ra activity based either on the mapping of alpha-decaying elements in the complete U-Ra series by alpha-radiography, or on the measurement of uranium alone by neutron induced fissionography, or on the alpha-decay measurement of /sup 222/Rn, the first daughter element of radium, and finally on the measurement of alpha-tracks originating from radium itself, which is separated from its parent nuclides are described in detail. (V.N.). 55 refs.

22983 **(BNL—39293) Fabrication of an 8:1 ellipsoidal mirror for a synchrotron x-ray microprobe.** Jones, K.W.; Takacs, P.Z.; Hastings, J.B.; Casstevens, J.M.; Pionke, C.D. (Brookhaven National Lab., Upton, NY (USA); Optic-Electronic Corp., Dallas, TX (USA)). 11 Jan 1987. Contract AC02-76CH00016. 17p. (CONF-870132—4). NTIS, PC A02. File Number DE87006457.

From LASE-13: pulse power for lasers conference; Los Angeles, CA, USA (11 Jan 1987).

The fabrication of an 8:1 demagnifying ellipsoidal mirror to be used for an x-ray microprobe at the National Synchrotron Light Source X-26 beam port is described. The design aim was to produce a mirror that could be used over the photon energy range from about 3 to 17 keV. The 300-mm long mirror was required to operate at a grazing angle of 5 mr. The semimajor axis was 4500 mm and the semiminor axis 14.142 mm. Surface roughness of 1 nm or less and slope errors of 1 arc second parallel to the long axis and 200 arc seconds parallel to the short direction were specified. Production of the first electroless nickel-coated aluminum mirror using a diamond-turning technique has been completed. The mirror meets the 1 arc sec surface figure specification except for areas near the ends of the mirror. The reasons for these deviations arise from subtle details of the diamond-turning process which have not been fully incorporated in to the computer program that controls the diamond-turning machines. Further work in computer correction of

repeatable errors of the diamond-turning machine can eliminate the waviness at the ends of the mirror. The diamond-turned mirror surface was not fully polished under this effort and therefore does not meet the roughness specification; however, surface smoothness of a fully polished cylindrical mirror manufactured using the same techniques does not meet the specification. It can be concluded that it is now technically feasible to meet the required specifications for the mirror and that the x-ray microprobe based on its use can be achieved.

22984 **(CONF-860983—3) Tributyltin chloride in water: Solid phase extraction, capillary GC [gas chromatography] separation and EC [electron capture] detection.** Junk, G.A.; Richard, J.J. (Ames Lab., IA (USA)). 23 Sep 1986. Contract W-7405-ENG-82. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005159.

From Oceans '86; Washington, DC, USA (23 Sep 1986).

A new procedure for determining trace levels of tributyltin chloride (Bu_3SnCl) present in seawater, without resorting to derivatization, has been developed. The stepwise approach involves: (1) solid phase extraction of Bu_3SnCl from 100 ml of water using 100 mg of C-18 bonded porous silica; (2) elution with HCl treated ethyl acetate to collect 50 μl of the eluate; (3) on-column injection of 1 μl of the eluate and separation on a 15 m DB-5 fused silica capillary column; and (4) detection of pg quantities of Bu_3SnCl by electron capture. All steps are amenable to automation allowing for low cost determinations of Bu_3SnCl and possibly other organotin compounds. Background and stability problems with both bonded porous and fused silica are described using test data from contrived and harbor water samples.

22985 **(CONF-861207—82) Laser photoacoustic spectroscopy for trace level detection of actinides in groundwater.** Doxtader, M.M.; Maroni, V.A.; Beitz, J.V.; Heaven, M. (Argonne National Lab., IL (USA); Illinois Inst. of Tech., Chicago (USA). Dept. of Chemistry). 1986. Contract W 31109-ENG-38. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006971.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In this paper we examine the utility of the laser photoacoustic spectroscopy (LPAS) technique for elucidating the chemical behavior of species present in the near-field environment of the Basalt Waste Isolation Project (BWIP) repository. We briefly review the existing basis for interpreting actinide spectra at low concentrations, and describe our initial experiments. These experiments include development and demonstration of the methodology under optimum conditions, e.g., stable, well-characterized solutions of holmium; and application of the technique to conditions relevant to the repository, including studies performed with uranium in synthetic groundwater and at elevated temperatures.

22986 **(CONF-861207—86) The Center for Materials Analysis: An important step to expedite materials research at Nanjing University.** Hongru, Z.; Nevitt, M.V. (Argonne National Lab., IL (USA); Nanjing Univ., JS (China). Center for Materials Analysis). Sep 1986. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004831.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

In 1983 Nanjing University, People's Republic of China, established a Center for Materials Analysis (CMA) with the support of the Chinese Ministry of Education. CMA acquired, and now operates and maintains, a wide spectrum of materials-oriented equipment for analysis and characterization studies by a University-wide user community, including external collaborators from industry and various scientific and technical professions. The CMA mode of operation has been found to provide wider, more cost-effective access to state-of-the-art, well-maintained facilities than the dispersion of equipment in various University departments and laboratories. In addition, CMA provides an effective locus for interdisciplinary research activities.

22987 **(DOE/EV/03120—1) Development and applications of photosensitive device systems to studies of biological and organic materials: Progress report for period June 1964-December 1986.** Reynolds, G.T.; Gruner, S.M. (Princeton Univ., NJ (USA)). Jan 1987. Contract AC02-76EV03120. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87006253.

A broad range of devices based on electro-optical technologies were developed and applied to the study of biological and other organic materials, ranging from single cell organisms to complex lipid liquid crystals. The detector systems developed have incorporated state of the art image intensifiers, vidicons, and solid state detectors. A major emphasis has been on the development of an x-ray image intensifier system suitable for diffraction experiments at high flux synchrotron sources. The detector has been applied to time resolved studies of lipid membrane phase transitions, with time resolution of the order of 10 msec. In addition, the x-ray detectors have been used to discover 3 cubic phases in the 1-methylphosphatidylethanolamine-water system, permitting a refinement of the phase transition theory developed earlier. The detectors have also been applied to low level light detection of selected luminescence phenomena. In particular, the cellular sources of bioluminescence in many organisms have been discovered, along with detailed information on the spectral distributions. Using the photoprotein aequorin and fluorescence techniques detailed studies have been made of free calcium release and uptake in a number of important metabolic processes. 11 refs.

22988 **(EIR—607) Instrumental neutron activation analysis of phosphorus in biological materials by Bremsstrahlung measurement.** Bajo, S.; Wyttenbach, A. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701511.

The determination of phosphorus in biological materials by instrumental neutron activation via the reaction /sup 31/P (n,γ) / sup 32/P is described. The Bremsstrahlung produced by /sup 32/P is measured in a well-type NaI(Tl) detector. The samples are measured within the polyethylene irradiation container with no changes between irradiation and measurement. The sources of error were studied and the proposed method was applied to the determination of phosphorus in ten internationally certified materials.

22989 **(GKSS—86/E/29) Reaction cross section measurement for 14 MeV neutron activation analysis at KORONA. Pt. 2.** Bahal, B.M.; Boessow, E.; Pepelnik, R.; Farooq, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751178.

Activation cross sections at 14.7 MeV neutron energy have been measured by means of conventional and cyclic activation techniques, utilizing the intense neutron generator KORONA at the GKSS Research Center Geesthacht. The reactions investigated are: (n,p): B-11, Na-23, Mg-25, Mg-26, Si-28, Si-29, Ti-46, Ti-47, Ti-48, V-51, Cu-65, Rb-85, Rb-87, Mo-92, Mo-96, Mo-97, Mo-98, Ba-136; (n,α): Na-23, Ti-50, Rb-85, Sr-88, Mo-92, In-115, Ba-138; (n,2n): Cl-35, Rb-85, Rb-87, Sr-86, Sr-88, Mo-92, Sb-121, Ba-130, Ba-132, Ba-134, Ba-136; Pb-204; (n,γ): Zr-96.

22990 **(GKSS—86/E/33) Fast neutron activation analysis.** Pepelnik, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751235.

Since 1981 numerous 14 MeV neutron activation analyses were performed at Korona. On the basis of that work the advantages of this analysis technique and therewith obtained results are compared with other analytical methods. The procedure of activation analysis, the characteristics of Korona, some analytical investigations in environmental research and material physics, as well as sources of systematic errors in trace analysis are described. With 27 figs., 7 tabs.

22991 (IA—1421, pp 112-113) **Measurement of secondary neutron energy spectra from (n,2n) reactions.** German, U.; Shani, G. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22992 (IA—1421, pp 113-114) **Study of the orientation of adsorbed N/sub 2/O molecules using nuclear resonance fluorescence.** Moreh, R.; Shahal, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22993 (IA—1421, pp 114) **Orientation of nitrate molecules in graphite-HNO/sub 3/ residue compounds.** Moreh, R.; Shahal, O.; Kimmel, G. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22994 (IA—1421, pp 139) **Instrumental epithermal neutron activation analysis of cadmium in biological matrices.** Mantel, M.; Lavi, N.; Alfassi, Z.B. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22995 (IA—1421, pp 193) **Analysis of solid samples in ICP-ES by direct insertion of a carbon cup into the tail of the source.** Lorber, A.; Goldbart, Z. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22996 (IA—1421, pp 105) **Evaluation of the distribution coefficient of silicon in cadmium using radioactive tracers.** Feldstein, H.; Aharonovitz, R.; Even, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

22997 (IAEA-RL—127) **Advances in chemical standards for nuclear fuel analysis and safeguards purposes. Report of a consultants' meeting on nuclear reference materials, needs and availability held in Antwerp, Belgium, 8-11 October 1985.** Bingham, C.; Brown, D.; Deron, S.; Vasilyev, V. (International Atomic Energy Agency, Vienna (Austria)). Oct 1985. 76p. (CONF-8510272—Summ.). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701514.

From IAEA consultants' meeting on nuclear reference materials needs and availability; Antwerp, Belgium (8 Oct 1985).
Tabs.

The objectives of the Consultants' Meeting were to evaluate the results of enquiries conducted by the IAEA and the CEC on the needs and availability of nuclear reference materials, to prepare a report on the results of the enquiries and on the advances in chemical standards for nuclear fuel analyses and safeguards purposes and to identify needs which are not being met or could not be met in the future.

22998 (IAEA-RL—127, pp 22-48) **1984 EC enquiry into the needs for nuclear reference materials (Z>89).** Verdingh, V. (USDOE New Brunswick Lab., NJ; UKAEA Atomic Energy Research Establishment, Harwell). Oct 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE87701514. (CONF-8510272—Summ.).

From IAEA consultants' meeting on nuclear reference materials needs and availability; Antwerp, Belgium (8 Oct 1985).

The study to justify and to quantify present and future needs of nuclear reference materials Z>89 in the European Community based upon the wide distribution of questionnaires and through direct contacts with scientists from industry and research laboratories is presented. 13 refs, 5 tabs.

22999 **(IFE/KR/E—86/002) Application of PNA-technique for the measurement of multi-phase flow.** Loevhoeiden, G.; Andersen, E.; Garder, K.; Rambaek, J.P. (Institute for Energy Technology, Kjeller (Norway)). Sep 1986. 16p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750688.

The pulsed neutron activation (PNA) technique is proposed for multi-phase flow monitoring of hydrocarbons. The reactions / sup 12/C(n,p)/sup 12/B and /sup 12/C(n,n')/sup 12/C both yield 4.4 MeV in the form of gamma radiation as a measure of carbon content. Intensity measurement of the 4.4 MeV gamma line gives a measure of the carbon content in the irradiation zone. By use of a pulsed neutron source, an estimation of the carbon content time variation is possible. In the presence of sulphur in petroleum, the reaction /sup 34/S(n,p)/sup 34/P offers a better possibility for flow rate determination. 23 refs.

23000 **(INIS-BR—577) Recuperation of uranium and gold in mineral pulps by adsorption.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1985. 14p. (In Portuguese). (CONF-8509369—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701446.

From 1. Brazilian congress on mining; Brasilia, Brazil (23 Sep 1985).

The technological routes for the treatment of the gold and uranium ores are presented. The results obtained during the continuous tests with the uraniferous Ores of Wabo in Somalia are presented. The utilization of 99% of the uranium content in the alkaline pulp is obtained. (C.B.).

23001 **(INIS-mf—10513) Verification of the visual control efficacity on quenching effect produced by Cr, Mn, Co and Fe in the uranium fluorimetric determination, by quantifying these metals with energy dispersive X-ray fluorescence.** Morales Sanchez, E.A. (San Carlos Univ. of Guatemala, Guatemala City. Facultad de Ciencias Quimicas y Farmacia). Aug 1986. 40p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701564.

It's described the APDC preconcentration procedure, applied to the quantification of chromium, manganese, iron and cobalt in river sediments which have been digested in order to evaluate their uranium content by fluorimetry. The purpose was to show the lack of correlation between the visual control of the quenching effect and its actual presence. A Cd-109 source and a Si-Li detector were used. Thin film method for avoiding matrix effects and a deconvolution soft-ware, AXIL, for correcting peaks overlapping were applied. Precision and accuracy were 2% and 10% respectively in the 2 to 5 micro-grams/milliliter range. It was shown that for the samples analyzed there was not a good correlation between the visual observations and the quenching effect. It was found that the principal - quencher was the iron, present in so high concentration that is caused up to 80% of attenuation.

23002 **(INIS-mf—10521) Non-destructive testing of proteins in single seeds using the /sup 14/N(d,p)/sup 15/N and / sup 14/N(d,proportional to)/sup 12/C reactions.** Moreno B, E. (Universidad Autonoma del Estado de Mexico, Toluca. Escuela de Ciencias Quimicas). 1986. 66p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87701566.

A non-destructive nuclear technique aimed for the analysis of proteins in single seeds using the /sup 14/N(d,p)/sup 15/N and / sup 14/N(d,proportional to)/sup 12/C reactions is implemented. This work was performed at the ININ's Tandem Van der Graaff facility, using a 6 MeV deuteron beam and a surface barrier solid state detector with its associated electronics for the pulse height analysis of the charged particles backscattered from the samples. Well defined populations of five varieties of wheat, and four of corn were used as samples in order to optimize the experimental conditions for the analysis, these results were compared with those obtained using an analytical chemical method (Kjeldahl). The linear

regression coefficient (''r'') obtained from the results of these two methods was: r = 0.9 in the case of wheat, and r = 0.7 in the case of corn, which we consider adequate figures for using the non-destructive nuclear technique as an aid or support in agricultural seed protein improvement programs. In adequate geometrical conditions the analysis per seed can take a few seconds, and the exposure to the germ can be as low as ≃1 Rad.

23003 **(INIS-mf—10550) Sodium chloride purification.** De la Roca Cuellar, W.A. (San Carlos Univ. of Guatemala, Guatemala City; Direccion General de Energia Nuclear, Guatemala City (Guatemala)). Aug 1986. 85p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701570.

Comparative evaluation of two methods of salt purification was made. Effects from factors as original salinity, crystallization speed and acidity were also studied. Impurities levels were determined by energy dispersive X-ray fluorescence analysis. Low efficiency for Fe elimination and an increase in Ba content were found for both methods.

23004 (INIS-mf—10574, pp 61-69) **Neutron activation analysis of reference materials.** Kucera, J.; Soukal, L. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

The importance is pointed out of neutron activation analysis in the preparation of reference materials, and studies are reported conducted recently by UJV. Instrumental neutron activation analysis has been used in testing homogeneity and in determining 28 elements in newly prepared reference standards of coal fly ash designated ENO, EOP and ECH. For accuracy testing, the same method was used in the analysis of NBS SRM-1633a Trace Elements in Coal Fly Ash and IAEA CRM Soil-5 and RM Soil-7. Radiochemical neutron activation analysis was used in determining Cd, Cu, Mn, Mo, and Zn in biological materials NBS SRM-1577 Bovine Liver, Bowen's Kale and in IAEA RM Milk Powder A-11 and Animal Muscle H-4. In all instances very good precision and accuracy of neutron activation analysis results were shown.

23005 (INIS-mf—10574, pp 71-76) **Instrumental neutron activation analysis of fly ash and aerosols.** Obrusnik, I. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Recent results obtained by instrumental neutron activation analysis (INAA) at UJV and the techniques used in analyzing coal fly ash and aerosols are summed up. A complex INAA procedure including both long-term and short-term irradiation allows determining more than 30 elements in such samples. Thus, fly ash can be distinguished emitted by brown coal-fired power plants from that emitted by large sources firing mazout; fly ash can even be differentiated from power plants burning brown coal of different origin. In analyzing aerosols, thanks to their reliability the INAA results for background aerosols are very important for the definition of pollution of large territorial areas in Czechoslovakia.

23006 (INIS-mf—10574, pp 79-84) **Determination of some rare earth elements in technological materials using neutron activation analysis and atomic absorption spectrometry.** Spevackova, V.; Posta, S. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska; Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Detection limits are compared for the two methods and for various rare earth elements, this for both individual elements and their mixtures. Thermal neutron cross sections, half-lives, gamma energies and interfering reactions are listed for neutron activation analysis of various elements. Both types of atomization, i.e., with flame and flameless were studied for atomic absorption spectroscopy. The formation of stable carbides was observed in spite of the fact that a pyrolytically treated cuvette had been used. The analysis is fast and highly selective but the standard addition method must be used. (M.D.).

23007 (INIS-mf—10574, pp 45-49) **Mass spectrometry applications at UJV.** Sus, F.; Klosova, E.; Moravec, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Mass spectrometry techniques developed and introduced by UJV are overviewed. They include mainly techniques used for the analysis of nuclear fuels, for age determinations of geological samples using the U-Pb, Rb-Sr and Sm-Nd methods, and the determination of element concentrations by the isotope dilution method.

23008 (INIS-mf—10574, pp 51-55) **Determination of uranium and plutonium.** Krtil, J.; Kuvik, V. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

The experience is described gained with the determination of uranium and plutonium contents in nuclear fuel samples over the ten-years' existence of the Central Testing Laboratory of the Nuclear Research Institute at Rez. The principles are shown of the techniques used, and the precision and correctness are given of the analytical results obtained with titration techniques in the determination of uranium and plutonium contents.

23009 (INIS-mf—10574, pp 57-59) **Applications of infrared spectroscopy in solving chemical problems at UJV.** Moravec, J.; Sara, V.; Sourkova, L. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

Ion exchanger radiolysis in the operating water filter of the reactor, and the variation of degradation of cation exchangers and anion exchangers with gamma radiation doses are discussed. The structure was assessed of rose bengal and that of UO/sub 2/(NO/sub 3/)/sub 2/ complexes with OETAPP was studied. For geological survey purposes, spectra were measured and interpreted of a series of uranium ores.

23010 (INIS-mf—10575, pp 303-310) **Direct uranium determination in boreholes by semiconductor gamma spectrometry using 1001.4 keV line - laboratory testing of method with respect to specific conditions of deposit exploited with hydrochemical techniques.** Bouda, T. (Ceskoslovensky Uranovy Prumysl, Straz pod Ralskem. Ustredni Laboratore). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

Two uranium ore standards of a cylindrical shape with a bore in the cylinder axis were used in the experiments. The measurements were performed using a Ge(Li) detector in 2π geometry. Sensitivity, reproducibility and detection limits of the method were determined. The uranium determination error depends on the measurement time and the concentration of uranium and of radon. /sup 234/Th interference takes place in measuring gamma radiation in leached solutions. The method has not yet been applied to deposits which are being exploited hydrochemically. (E.S.).

23011 (INIS-mf—10575) **Mining Pribram in science and technology. Modern methods of analytical process testing.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague). 1985. 91p. (In Czech). (CONF-8510403—Exc.). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445.

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The symposium on modern methods of analytical testing of technological processes held in October, 1985 in Czechoslovakia heard a total of 32 papers of which 11 were inputted in INIS. These papers deal with X-ray fluorescence determination of uranium in solutions, the separation of rare earth elements by oxalate precipitation, the application of fluorimetry in inorganic analysis, gadolinium determination in uranium ores, with isotachophoresis applications, nitrogen oxide determinations in gaseous products of pressure leaching of uranium ores, the development of automatic analyzers, the applications of an extraction spectrophotometric analyzer, and a radiometric system for controlling sorption and elution. (J.C.).

23012 (INIS-mf—10575, pp 57-67) **X-ray fluorescence analysis of U in solution using a double correction for background-scattered radiation.** Hora, V. (Ceskoslovensky Uranovy Prumysl, Straz pod Ralskem. Ustredni Laboratore). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The application is discussed of X-ray fluorescence analysis in the study of geological materials, mainly in the determination of uranium and other elements in the liquid phase. The method guarantees sensitivity, accuracy and selectivity of determination and the possibility of automating the measuring and evaluation processes. A method of double correction for radiation scattered in the background was used to improve the accuracy of results, this in view of considerable differences in the contents of soluble components in the solutions. (J.C.).

23013 (INIS-mf—10575, pp 73-88) **Advances in the use of fluorimetry in inorganic analysis.** Holzbecher, Z. (Vysoka Skola Chemicko-Technologicka, Prague, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The applications are discussed of lasers in time-differentiated fluorimetry, and the exceptional selectivity and sensitivity are shown of the method (of the order of fg/ml). The method can be used in determining uranium in a 10% solution of H/sub 3/PO/sub 4/ or HF within 0.1 mg/ml and 10 pg/ml with an accuracy of +-(1-8)%, this thanks to the iong life of UO/sub 2//sup 2+/ luminescence. A new method is described of measuring luminescence of crystalline luminous materials, SEPIL (Selective Excitation of Probe Ion Luminescence), based on splitting the electron level of incomplete f orbitals into a series of levels by the action of the crystal field. SEPIL allows determining 10 fg/ml of uranium in drinking water. The detection limit for lanthanides is 0.4 pg/ml. (J.C.).

23014 (INIS-mf—10575, pp 112-118) **Possible determination of gadolinium in uranium.** Spevackova, V. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The possible determination was studied of gadolinium in the presence of uranium using atomic absorption spectrometry and electrothermal atomization. The unfavourable effect was studied of high uranium concentrations on gadolinium determination. The separation of gadolinium from uranium is mostly performed using ion exchangers or extraction. For determining the quality of nuclear fuel containing 0.1 to 10 mg Gd per 1 g UO/sub 2/, separation of gadolinium from the uranium fuel and its concentration are necessary. (J.C.).

23015 (INIS-mf—10575, pp 187-192) **Applications of isotachophoresis by Central Laboratories, Czechoslovak Uranium Industry.** Ryslavy, Z. (Ceskoslovensky Uranovy Prumysl, Straz pod Ralskem. Ustredni Laboratore). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The application is described of isotachophoresis in the analysis of rare earth elements. The following electrolyte system was used in the separation of the individual lanthanides: leading electrolyte: 0.025 to 0.030 M NH/sub 4//sup +/, 0.014 to 0.017 M α-hydroxyisobutyric acid, 0.2 to 0.4% of hydroxyethyl cellulose, and acetic acid up to pH 4.9 to 5.1; trailing electrolyte: 0.02 M uranyl acetate, pH 4.25. The separation and detection of a 10/sup -4/ M mixture of lanthanides proceeded 45 minutes. The requirements are discussed placed by the physico-chemical basis of the method for its successful application. The advantage of the method is very low sample consumption. (J.C.).

23016 (INIS-mf—10575, pp 261-265) **Development of automatic analyzers by the Czechoslovak Uranium Industry.** Homolka, V.; Radil, V. (Ceskoslovensky Uranovy Prumysl, Pribram; Vyvojovy Zavod Uranoveho Prumyslu, Zbraslav nad Vltavou, Czechoslovakia. Ustav Jadernych Paliv). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

The possibility is discussed of replacing chemical analyses in the laboratory by automatic analyzers in the field in association with continuous sampling. Attention is paid to the automation of analytical determination of uranium in solutions from hydrochemical mining. A direct spectrophotometric method was developed based on the reaction of UO/sub 2//sup 2+/ ions with the Arsenazo III reagent in a single-phase dioxane-ethanol-water medium. The results are discussed of Stage 1 of the project "Development of chemical methods and equipment for automatic process control" solved in the period 1981-1983. Stage 2 (1983-1986) is mainly devoted to the development and design of a modular analyzer for the determination of uranium and to microprocessor-based control systems. (J.C.).

23017 (INIS-mf—10575, pp 266-270) **Automation of analytical work at a chemical extraction mine.** Makovicka, J. (Uranove Doly, Hamr, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

Uranium in the solution is determined using an automatic analyzer operating in a discontinuous mode, based on the principle of direct uranium photometry using the Arsenazo III reagent. An envisaged development is discussed of automatic analyzers using data processing which would eliminate the human factor effect. (J.C.).

23018 (INIS-mf—10575, pp 281-289) **Extraction spectrophotometric analyzer.** Batik, J.; Vitha, F. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

Automation is discussed of extraction spectrophotometric determination of uranium in a solution. Uranium is extracted from accompanying elements in an HCl medium with a solution of tributyl phosphate in benzene. The determination is performed by measuring absorbance at 655 nm in a single-phase ethanol-water-benzene-tributyl phosphate medium. The design is described of an analyzer consisting of an analytical unit and a control unit. The analyzer performance promises increased productivity of labour, improved operating and hygiene conditions, and mainly more accurate results of analyses. (J.C.).

23019 (INIS-mf—10575, pp 68-72) **Decomposition of rare earth element raw materials and the method of separating the elements by oxalate precipitation.** Weiss, D. (Ustredni Ustav Geologicky, Prague, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701445. (CONF-8510403—Exc.).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (14 Oct 1985).

Methods are described of obtaining rare earth elements from natural raw materials with various contents of the elements. Atomic absorption spectrometry and X-ray fluorescence analysis are mainly used for the analysis of these raw materials, which requires the preparation of representative solutions by suitable decomposition of the raw material. The decomposition which depends on the material's phase composition is effected using inorganic acids or by sintering the sample with a mixture of anhydrous sodium carbonate and sodium peroxide, by leaching the melt with water and dissolving the precipitate in diluted HCl or HNO/sub 3/. A chloride solution (pH 1.1-1.2) is the most suitable medium for quantitative precipitation of oxalates of rare earth elements. (J.C.).

23020 (INIS-mf—10577, pp 71-74) **Cumulation of elements on algal cell walls.** Stary, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Katedra Jaderne Chemie). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23021 **(INIS-mf—10577) Separation of ionic solutes. Abstracts of papers.** (Slovak Chemical Society, Bratislava (Czechoslovakia). Nuclear Chemistry Section; Komenskeho Univ., Bratislava (Czechoslovakia)). 21 Apr 1986. 31p. (In English and Russian). (CONF-8509125—Exc.-Absts.). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572.

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

The conference proceedings contain 44 papers of which 19 were incorporated in INIS. The subject of these is the use of solvent extraction or emulsion membrane extraction for separation of fission products, rare earth compounds and actinide compunds; the sorption of radionuclides; and the use of adsorbents and chelating agents in separation processes. (J.P.).

23022 (INIS-mf—10577, pp 25) **Separation of ionic radioiodine by selective sorbents with increased dynamic efficiency.** Jansta, J. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23023 (INIS-mf—10577, pp 26) **Description of the extraction of microamounts of Am(III) in the presence of macroamounts of lanthanides.** Jedinakova, V.; Dvorak, Z.; Zilkova, J. (Vysoka Skola Chemicko-Technologicka, Prague, Czechoslovakia. Katedra Technologie Jadernych Paliv a Radiochemie). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23024 (INIS-mf—10577, pp 32) **Extraction of cerium(III) by di-2-ethylhexylphosphoric acid and tri-n-octylphosphine oxide in liquid membrane emulsion system.** Kopunec, R.; Rezbarik, J.; Stefunkova, E. (Komenskeho Univ., Bratislava, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23025 (INIS-mf—10577, pp 40-43) **Separation of fission products by solvent extraction with dicarbollide in radioanalytical chemistry and technology.** Kyrs, M.; Rais, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23026 (INIS-mf—10577, pp 44-47) **Membrane extraction for preconcentration of radionuclides.** Macasek, F. (Komenskeho Univ., Bratislava, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23027 (INIS-mf—10577, pp 50) **Emulsion membrane extraction of strontium and its separation from calcium utilizing crown and picric acid.** Mikulaj, V.; Hlatky, J. (Komenskeho Univ., Bratislava, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23028 (INIS-mf—10577, pp 52) **Continuous preconcentration of cobalt and uranium using liquid emulsion membranes.** Mikulaj, V.; Rajec, P.; Svec, A.; Nguyen Huy Cuong; Vu Ngoc Ahn. (Komenskeho Univ., Bratislava, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23029 (INIS-mf—10577, pp 56) **New phosphorus containing extractants for separation of metals.** Navratil, O.; Herrmann, E. (Universita J.E. Purkyne, Brno, Czechoslovakia. Ustav Anorganicke Chemie; Technische Univ., Dresden, German Democratic Republic. Sektion Chemie). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23030 (INIS-mf—10577, pp 57) **Preconcentration in static and dynamic extractive separations.** Palagyi, S. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23031 (INIS-mf—10577, pp 59) **Extraction of Hf(IV) from mineral acid solutions by diphenylphosphinic acid in chloroform.** Prihoda, J.; Zichackova, D. (Universita J.E. Purkyne, Brno, Czechoslovakia. Ustav Anorganicke Chemie). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23032 (INIS-mf—10577, pp 61-64) **Solvent extraction of some metals from aqueous solutions.** Sato, T. (Shizuoka Univ., Hamamatsu, Japan. Faculty of Engineering). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23033 (INIS-mf—10577, pp 84) **Use of 18-crown-6 and its derivates for concentration and selective separation of strontium(II) and for sub- and super-equivalence method of isotope dilution analysis.** Vanco, D.; Misianik, J.; Lesny, J. (Vyskumny Ustav Preventivneho Lekarstva, Bratislava, Czechoslovakia; Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Chemickotechnologicka Fakulta). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23034 **(INIS-mf—10581) Fourth Australian conference on nuclear techniques of analysis: Proceedings.** (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). Nov 1985. 279p. (CONF-851194—). NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623.

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Conference sessions covered the areas of materials science, semiconductors, ceramics and metals, archaeometry, industrial applications, environmental applications, bioscience, instrumentation, surfaces and geoscience.

23035 (INIS-mf—10581, pp 26-28) **Neutron coincidence counting.** Hines, M.G.; Boldeman, J.W.; Thorpe, K.J.; Delaney, I.; Fallon, J.P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Applied Physics Div.). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Neutron coincidence counting is an established technique for the assay of plutonium waste from nuclear reactors and reprocessing plants. There are, however, basic limitations on existing instrumentation. This paper presents an outline of an original method of Pu assay based on a high efficiency liquid scintillation counter. Progress made using a recently constructed liquid scintillator is also included.

23036 (INIS-mf—10581, pp 32-35) **Current studies of biological materials using instrumental and radiochemical neutron activation analysis.** Fardy, J.J.; McOrist, G.D.; Farrar, Y.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Energy Chemistry). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Instrumental neutron activation analysis still remains the preferred option when analysing the trace element distribution in a wide rage of materials by neutron activation analysis. However, when lower limits of detection are required or major interferences reduce the effectiveness of this technique, radiochemical neutron activation analysis is applied. This paper examines the current use of both methods and the development of rapid radiochemical techniques for analysis of the biological materials, hair, cow's milk, human's milk, milk powder, blood and blood serum.

23037 (INIS-mf—10581, pp 36-38) **X-ray reflection analysis techniques using PIXE facilities.** Scott, M. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Chemical Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

X-ray reflection has been investigated as a surface analytical technique offering multi element density measurements for films up to 10 wavelengths thick. Wavelengths up to 0.8 nm, corresponding to the A1 kα line are routinely accommodated in existing PIXE analysis facilities as installed on the 3 MV accelerator at Lucas Heights. For this wavelength the critical angle for reflection from glass is approx. 2 deg. X-rays of longer wavelengths can easily be generated but are strongly adsorbed in the SiLi detector window.

23038 (INIS-mf—10581, pp 39-41) **Backscattering analysis of AuGe-Ni ohmic contacts of n-GaAs.** Nassibian, A.G.; Kalkur, T.S.; Sutherland, G.J.; Cohen, D. (Western Australia Univ., Nedlands; Australian Inst. of Nuclear Science and Engineering, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

AuGe-Ni is widely used for the fabrication of ohmic contacts to n-GaAs. The alloying behaviour of evaporated AuGe-Ni alloyed by furnace and Scanning Electron Beam, is characterised by Rutherford backscattering with 2MeV /sup 4/He ions. Since the formation of alloyed AuGe-Ni contacts involves redistribution and diffusion of Ga, As, Ni, Ge and Au, it is difficult to separate the corresponding yields due to gold, Ga, As, Ni and Ge in the spectrum. The technique used in the investigation involves assumption of depth distribution of elements and computing the resultant spectrum.

23039 (INIS-mf—10581, pp 45) **Carbon depth profiling using resonant elastic alpha scattering.** Ryan, C.G.; Sie, S.H.; McKenzie, D.R.; Smith, G.B. (Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia. Div. of Mineral Physics; Sydney Univ., Australia. School of Physics; New South Wales Inst. of Tech., Broadway, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

23040 (INIS-mf—10581, pp 46-48) **Elemental microanalysis of mouse ileum tissue.** Kirby, B.J.; Legge, G.J.F. (Melbourne Univ., Parkville, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A scanning proton microprobe has been used for a preliminary investigation of the cellular distribution of heavy metals and other elements in mouse ileum tissue. In order to study the cellular and elemental morphology of a villus the spatial distributions of the yields of characteristic X-rays are compared to a photomicrograph of the irradiated tissue and to a stained adjacent tissue section.

23041 (INIS-mf—10581, pp 49-51) **Performance of a high brightness field ionization ion source.** Allan, G.L.; Zhu, J.; Legge, G.J.F. (Melbourne Univ., Parkville, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A Gas Phase Field Ionization Ion Source has been built specifically for use with the University of Melbourne Proton Microprobe. The source is extremely bright making it suitable for use with high resolution probe forming systems. Beam current stability and emitter lifetime is greatly enhanced by the use of iridium field emitters, allowing for reproducible source performance. Current output as a function of source parameters has been measured indicating that nano amps of current are available in a beam up to 10/ sup 5/ times brighter than that presently used in the Melbourne probe.

23042 (INIS-mf—10581, pp 52-54) **Analysis by PIXE and PIGME of biomineralized tissues in the chiton Clavarizona hirtosa.** Kim, K.-S.; Webb, J.; Macey, D.J.; Cohen, D.D. (Murdoch Univ., Perth, Australia; Australian Inst. of Nuclear Science and Engineering, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Procedures have been developed to determine, by PIXE and PIGME, the elemental composition of small samples (ca. 1 mg) of

biomineralized tissue. The Fe, Ca and P contents of the radula of the chiton C. hirtosa increase considerably from the early to the late stage of mineralization. However, Fe is absent, indicating that at least in C. hirtosa, Ca and P biomineral deposits are most likely hydroxyapatite rather than fluoroapatite which has been reported in several other species.

23043 (INIS-mf—10581, pp 55-57) **Trace element analysis of archaeological artefacts from Pella, Jordan.** Clayton, E.; Randle, L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights; Sydney Univ., Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A brief history of the site at Pella, Jordan is presented, as a prelude to an analysis of the element composition of 82 pottery sherds. Statistical results from this data support the archaeological evidence for occupation during the Late Bronze and Early Iron Age.

23044 (INIS-mf—10581, pp 58-63) **Comparison of methods of analysis for natural environmental radionuclides, especially Th and U, at the level of a few μg.g/sup -1/.** Hutton, J.T.; Prescott, J.R.; Wall, T. (Adelaide Univ., Australia. Dept. of Physics; Australian Atomic Energy Commission Research Establishment, Lucas Heights. Applied Physics Div.). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Both thermoluminescence and electron spin resonance methods of dating archaeological and geological events require the determination of the natural radiation dose. In situ thermoluminescence dosimetry is accepted as standard but is not practical at all sites and requires up to twelve months' exposure. Analyses for the radioactive elements potassium, thorium and uranium can be made by a number of analytical techniques and comparison over several years has shown no essential difference between XRF and NAA for thorium and DNA for uranium. Thick source alpha counting is also used as a simple, independent laboratory check for thorium and uranium and also as an indicator of disequilibrium. Recently a portable gamma-ray scintillometer has been calibrated and is proving very satisfactory for the determination of total gamma ray dose in the field.

23045 (INIS-mf—10581, pp 64-66) **Artefact identification.** Bird, J.R.; Duerden, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The measurement of elemental composition is a powerful tool for comparing artefact obsidian with potential source material and ion beam analysis techniques have proved very successful for this work.

23046 (INIS-mf—10581, pp 67-69) **Recent applications of neutron activation analysis in geoscience at Lucas Heights.** Fardy, J.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Energy Chemistry). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

In spite of developments in instrumental techniques of analysis over the last decade, neutron activation analysis has maintained its importance as a multielemental technique for analysing a wide range of geological materials. Some of its applications in geoscience at Lucas Heights over the last two years are discussed. These include hydrogeochemical and geological prospecting for gold in geothermal and bore water systems and ores, rare earth characterisation of shoshonitic lavas, altered basalts and dacites, and trace element studies of Australian oil shales and coals.

23047 (INIS-mf—10581, pp 74-76) **XPS studies of valence states of lanthanide and actinide elements in SYNROC C.** Szajman, J.; Myhra, S.; Smart, R.St.C. (Griffith Univ., Brisbane, Australia. School of Science). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

High level nuclear waste (HLW) is simulated in part by addition of small quantities of lanthanides and actinides to the SYNROC precursor slurry. There are two main parameters which influence the crystallographic destination of the HLW species - the cation size and its valence state. X-ray photoelectron spectroscopy was used to investigate the valence states of rare earth elements in SYNROC. Experimental difficulties are considerable at concentrations approaching detection limits in a solid with up to 20 different elements. Some successful observations will be described and their implications for the structural chemistry will be discussed.

23048 (INIS-mf—10581, pp 83-85) **Use of neutron activation for the rare earth element analysis of granitic rocks and minerals.** Wall, T. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Neutron activation is a well tested analytical method for obtaining geochemical data. Although it cannot be applied to any rock type with equal reliability, it is commonly used to provide rare earth and other trace element analyses of granitic rocks and minerals. An example is given in which NAA of over 80 rock and mineral specimens was carried out of granitic specimens from eastern Australia.

23049 (INIS-mf—10581, pp 89-94) **Application of a scanning proton microprobe to biological and medial research.** Mazzolini, A.P.; O'Brien, P.M.; Legge, G.J.F. (Melbourne Univ., Parkville, Australia. School of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

This paper briefly summarizes the need for trace elemental microanalysis in the biological and medical sciences. It discusses some of the specific problems associated with the preparation, handling and irradiation of fragile soft tissues and isolated cells, and how these problems can be solved. The advantages of total, quantitative data collection and analysis are also discussed.

23050 (INIS-mf—10581, pp 95-100) **Nuclear analysis methods in monitoring occupational health.** Clayton, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Applied Physics Div.). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

With the increasing industrialisation of the world has come an increase in exposure to hazardous chemicals. Their effect on the body depends upon the concentration of the element in the work environment; its chemical form; the possible different routes of intake; and the individual's biological response to the chemical. Nuclear techniques of analysis such as neutron activation analysis (NAA) and proton induced X-ray emission analysis (PIXE), have played an important role in understanding the effects hazardous chemicals can have on occupationally exposed workers. In this review, examples of their application, mainly in monitoring exposure to heavy metals is discussed.

23051 (INIS-mf—10581, pp 105-107) **Microprobe analysis of human fibroblasts.** Allan, G.L.; Zhu, J.; Legge, G.J.F.; Camakaris, J. (Melbourne Univ., Parkville, Australia. School of Physics; Melbourne Univ., Parkville, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The Melbourne Proton Microprobe has been used to study the copper content in human skin fibroblast cells derived from patients with the genetic disease Menkes Syndrome. Both normal and diseased cells have been studied to investigate any elemental differences occurring between the two cell types. This paper details the preparatory techniques necessary for individual cell analysis and presents the elemental information with a new three dimensional contour mapping technique. These maps are used to highlight elemental differences between normal and mutant fibroblasts. The work also confirms the expected copper excess found in the Menkes cell and indicates that the microprobe can be used for rapid identification of a Menkes carrier.

23052 (INIS-mf—10581, pp 108-110) **Incorporation of trace metals and radionuclides into goethite.** Gerth, J.; Davey, B.G.; Cockayne, D.J.H. (Sydney Univ., Australia. Dept. of Soil Science; Sydney Univ., Australia. School of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The elements Ni, Co, Cu, Zn, Cd and Th can be incorporated into the structure of goethite in greater amounts than U (as UO/sub 2//sup 2+/). These elements cause significant changes in the morphology and d-spacing of the goethite. The concentrations of Zn, Cd, and Th in the goethite were analysed by X-ray spectroscopic analysis in the electron microscope.

23053 (INIS-mf—10581, pp 117-119) **Multi-elemental analysis techniques at Lucas Heights.** Cohen, D.D. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A description is given of the wide range of multi-elemental analysis techniques available at Lucas Heights which includes PIXE/HIXE, RBS, FERA, PIGME, PINRA and NAA.

23054 (INIS-mf—10581, pp 120-121) **Scattering of low energy hydrogen ions from single crystal surfaces.** MacDonald, R.J.; O'Connor, D.J. (Newcastle Univ., Australia. Dept. of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

23055 (INIS-mf—10581, pp 138-140) **Evaluation of computer modelling programs for RBS analysis of oxidised surfaces.** Saulitis, J. (Materials Research Labs., Maribyrnong, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The efficacy of three computer programs in analyzing nuclear backscattering spectra is described. The parentage and the different design approaches of the programs PROFILE, SCATT and CALC are examined. Their capabilities both designed practical are examined and contrasted. Also the working limits of the actual programs are reported.

23056 (INIS-mf—10581, pp 141-144) **Neutron and gamma-ray transmission technique for the on-line determination of moisture in coal and coke.** Sowerby, B.D.; Millen, M.J.; Rafter, P.T. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A fast neutron and gamma-ray transmission technique is being developed for the on-line analysis of moisture in coal and coke. The technique utilises /sup 252/Cf and /sup 137/Cs sources and /sup 3/He and NaI(Tl) detectors. Laboratory measurements on single coal samples have shown that moisture can be determined to better than 1 wt% over the range 0 to 16 wt% moisture and 5 to 17cm thickness. Reduced errors were obtained for restricted ranges of moisture and thickness. Preliminary measurements on coke of thickness 30 to 50cm have shown that moisture can be determined to within 0.26 wt% over the range 1 to 16 wt% moisture.

23057 (INIS-mf—10581, pp 146-148) **Atom location using recoil ion spectroscopy.** O'Connor, D.J. (Newcastle Univ., Australia. Dept. of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Low energy ion scattering (LEIS) using inert gas and alkali ions is widely used in studies of the surface atomic layer. The extreme surface sensitivity of this technique ensures that it yields both compositional and structural information on clean and adsorbate covered surfaces. Low Energy Negative recoil Spectroscopy (LENRS) has been applied to a study of oxygen on Ni(110) to gauge the sensitivity to coverage and site location.

23058 (INIS-mf—10581, pp 149-151) **Uranium minerals in veins in the Ranger No. 3 ore body.** Gray, D.J.; Davey, B.G.; Benson, D. (Sydney Univ., Australia. Dept. of Soil Science; Sydney Univ., Australia. School of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Uranium bearing veins in partially weathered rock from Ranger No. 3 ore body, Northern Territory, Australia, were found to contain saleeite by electron probe microanalysis. The saleeite seems to have been formed by oxidation of the uraninite and subsequent precipitation. The chlorite, mica and quartz adjacent to the saleeite vein appeared to be unaltered which suggests that the solutions causing alteration moved through the vein system. It follows that the sources of magnesium and phosphate for saleeite formation were not local in origin. As the U lost from the vein during alteration of uraninite to saleeite was not deposited in the vicinity of the vein studied, U loss also probably took place through the vein system.

23059 (INIS-mf—10581, pp 152-154) **Use of neutron activation analysis to measure the variation in trace element concentrations in a coal seam.** Fardy, J.J.; Swaine, D.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights, Australia. Div. of Energy Chemistry; Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia. Div. of Fossil Fuels). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Trace element concentrations were measured by neutron activation on 57 run-of-mine coal samples from several locations in seven mines located in the Lithgow seam in the Western Coalfield, Sydney Basin. Results were tabulated as ratios of the highest to the lowest variance for each element.

23060 (INIS-mf—10581, pp 171-174) **Density measurements in a heterogeneous soil system.** Wilson, D.J.; Plotnikoff, W.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The interpretation of moisture probe measurements is strongly dependent on the dry soil density. This paper discusses the deri-

vation of a gamma density probe calibration curve for use in a heterogeneous material, and whether the constituents of a mine overburden heap be within the limits imposed by the technique. The effects of soil variability on the density precision and on the subsequent moisture measurement are considered.

23061 (INIS-mf—10581, pp 178-180) **Application of fission track analysis to hydrocarbon exploration.** Duddy, I.R.; Green, P.F.; Gleadow, A.J.W.; Marshallsea, S.; Tingate, P.; Laslett, G.M.; Hegarty, K.A.; Lovering, J.F. (Melbourne Univ., Parkville, Australia. Dept. of Geology). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The temperature range over which fission tracks in apatite show observable annealing effects coincides with that responsible for the maximum generation of liquid hydrocarbons. Work is currently in progress in a number of Australian and overseas sedimentary basins, applying Apatite Fission Track Analysis (AFTA) to investigate the thermal evolution of these hydrocarbon prospective regions.

23062 (INIS-mf—10581, pp 181-183) **REE determinations in single mineral grains using RNAA.** Bishop, J. (Melbourne Univ., Parkville, Australia. Dept. of Geology). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Rare earth elements (REE) are determined with ppm sensitivity in single mineral grains by radiochemical neutron activation analysis (RNAA) using a fusion dissolution process and a quantitative group separation scheme followed by radioassaying.

23063 (INIS-mf—10581, pp 213-219) **Some hazards of using Rutherford backscattering and channeling techniques in materials science studies.** Sood, D.K. (Royal Melbourne Institute of Technology, Microelectronics Technology Centre, Melbourne, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Excessive reliance on data obtained by RBS and channeling techniques can sometimes produce misleading conclusions. The occurrence of lateral non-uniformities or coherent second phases is the main culprit which can escape notice unless an additional technique is employed as a watchdog. Several examples are presented.

23064 (INIS-mf—10581, pp 220-224) **Channeling contrast microscopy: a new technique for microanalysis of semiconductors.** McCallum, J.C.; Williams, J.S. (Melbourne Univ., Parkville, Australia. School of Physics; Royal Melbourne Inst. of Tech., Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The technique of channeling contrast microscopy has been developed over the past few years for use with the Melbourne microprobe. It has been used for several profitable analyses of small-scale structures in semiconductor materials. This paper outlines the basic features of the technique and examples of its applications are given.

23065 (INIS-mf—10581, pp 228-230) **Advantages of combining ion beam techniques for surface layer analysis.** Duerden, P.; Clayton, E.; Cohen, D.D.; Dragovich, D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights; Australian Inst. of Nuclear Science and Engineering, Lucas Heights; Sydney Univ., Australia. Dept. of Geography). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The problem of elemental composition analysis for a variable thickness surface layer has been investigated. Both protons and alpha-particles with a range of energy were used as the incident ions for PIXE, PIGME and RBS measurements so that the variation of elemental composition as a function of surface thickness could be studied. An example of measurements on desert varnish coatings on underlying rock is given.

23066 (INIS-mf—10581, pp 236-237) **Low level detection and visualisation of fissile and alpha emitting nuclides by solid state nuclear track detectors.** Ellis, W.R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The number and variety of applications of nuclear track techniques in various branches of science are increasing steadily. Their ease of use, and sensitivity, particularly their ability to determine the amount and distribution of low levels of alpha emitters and/or fissile materials in a wide range of substances, ensure that these techniques will continue to be in demand.

23067 (INIS-SU—392, pp 536) **Measurement of protein distribution along seed depth using deuteron reactions.** Melenevskij, A.Eh.; Lyubinskij, N.N.; Nemykin, V.I.; Tikhij, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23068 (INIS-SU—392, pp 540) **Method of nuclear microanalysis of carbon based on sup(13)C(d,t)sup(12)C reaction.** Gurbich, A.F.; Majsyukov, V.D.; Shorin, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23069 (INIS-SU—392, pp 566) **Determination of concentration of some plant elements in reactions with charged particles.** Mukhammedov, S.; Tillaeva, Kh.; Badalov, N.B. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23070 (INP—1215/C) **Investigation on the influence of the concentration of Zr-ions in model extraction systems TBP - diluent - Sr/sup +4/-HNO/sub 3/. Pt.1.** Rogoz, F. (Institute of Nuclear Physics, Krakow (Poland)). 1983. 23p. (In Polish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701577.

The influence of zirconium ions on the stability of the primary emulsion in the model extraction systems was examined and it was found out that zirconium ions in the systems containing TBP only cause a slight increase of the stability of the primary emulsions. The addition of MBP causes precipitation of sediments that fix the emulsions and makes phase separation difficult. The addition of DBP increases the stability of the primary emulsion. Kerosene as the diluent of TBP increases the stability of the primary emulsions more than carbon tetrachloride does.

23071 (INP—1226/C) **Investigation on the influence of the concentration of Zr-ions in model extraction systems TBP - diluent - Zr/sup +4/-HNO/sub 3/. Pt. 2.** Rogoz, F.; Tlalka, M. (Institute of Nuclear Physics, Krakow (Poland)). 1983. 20p. (In Polish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701578.

The model extraction systems were examined on creation of the primary emulsion. In the systems containing mixtures of the TBP, MBP, DBP and n-butyl alcohol, zirconium ions cause a big increase of the stability of the primary emulsions in the definite

ranges of concentration. The addition of MBP and DBP makes the primary emulsion strong fixed in kerosene and carbon tetrachloride, but at different nitric acid concentrations. N-butyl alcohol causes a slight decrease of the stability of the primary emulsion.

23072 **(INR—1954/15-A/C/B) Determination of tin in geological samples by low resolution radioisotope X-ray fluorescence.** Kowalska, E.; Urbanski, P. (Institute of Nuclear Research, Warsaw (Poland)). 1982. 15p. (In Polish). Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

Published in 1983.

A new version of the method of tin determination in geological samples was proposed. Fluorescence analyzer AF-101, Am-241 point source and krypton filled proportional counter were used. Several algorithms for tin determination were presented and criteria for their selection were discussed. Developed method and instrument provided 0.03% Sn (1 standard deviation) precision and about 0.01% Sn determination limit in the concentration range 0.03% to 0.5% Sn. The method appears useful for both tin selection and accurate quantitative analysis of geological samples.

23073 **(Juel-Spez—365) Instrumental neutron activation analysis of site-dependent uptake and distribution of trace elements in the saltmarsh plant Aster tripolium from marsh fields in the Schelde estuary, Netherlands.** Rossbach, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie; Koeln Univ. (Germany, F.R.)). Jul 1986. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751318.

As part of an environmental chemical investigation the uptake of heavy metals by a saltmarsh plant Aster tripolium from two differently polluted salt marsh sites of the North Sea between 20 to 30 trace elements were determined in soil and plant organs. A sensitive gamma ray counting system was installed and tested for instrumental activation analyses (INAA). Installations to improve sensitivity as well as conditions necessary for reliable trace element analysis with the aid of Anticompton spectrometers (ACS) are described. The accuracy and reproducibility of the method was determined by the analysis of reference- and control materials of the german environmental specimen bank. In order to characterise the state of pollution of the salt marsh soils pollution-factors for single elements as well as interelemental correlations were evaluated. In addition, uptake and translocation factors of the biological samples were calculated. The many highly significant correlations between elements within the plant organs indicated that uptake appears to be physiologicaly controlled and not dependent on soil concentration. In order to detect further consequences of differing pollution influences within these plants biochemical separation techniques were applied and trace element levels in selected extracts were determined. For the specification of heavy metals gelpermeation chromatography of ethanolic extracts proved to be the most promising method. Furthermore, propositions for the use of trace elements as a fingerprint for pollution status and characterisation of species for referenz- and specimenbank materials have been developed. Aster tripolium as a cadmium accumulating plant can probably be used as an indicator in the monitoring of cadmium polluted salt marsh areas.

23074 **(NBL—306) Interlaboratory comparison program for nondestructive assay of prototype uranium reference materials.** Trahey, N.M.; Smith, M.M.; Voeks, A.M.; Bracey, J.T. (USDOE New Brunswick Lab., Argonne, IL). Dec 1986. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87004733.

The US Department of Energy (DOE), New Brunswick Laboratory (NBS), designed and administered an interlaboratory comparison program based on the measurement of NBL-produced prototype uranium nondestructive assay (NDA) reference materials for scrap and waste. The objectives of the program were to evaluate the reliability of NDA techniques as applied to nuclear safeguards materials control and accountability needs and to investigate the feasibility of providing practical NDA scrap and waste reference materials for use throughout the nuclear safeguards community. Fourteen facilities representing seven DOE contractors, four US Nuclear Regulatory Commission (NRC) licensees, one EURATOM Laboratory, and NBL, participated in this program. Three stable, well-characterized uranium reference materials were developed and certified for this program. Synthetic calcined ash, cellulose fiber, and ion-exchange resin simulate selected uranium scrap and waste forms which are often encountered in fabrication and recovery operations. The synthetic calcined ash represents an intermediate density inorganic matrix while the cellulose fiber and ion-exchange resin are representative of low-density organic matrices. The materials, containing from 0 to 13% uranium enriched at 93% ^{235}U, were sealed in specially selected containers. Nineteen prototype reference samples, plus three empty containers, one to accompany each set, was circulated to the participants between August 1979 and May 1984. Triplicate measurements for ^{235}U on each of the 19 filled containers were required. In addition, participants could opt to perform modular configuration measurements using containers from Sets IIA and IIB to simulate non-homogeneously dispersed uranium in waste containers. All data were reported to NBL for evaluation.

23075 **(OEFZS-A—0901) Occurrence of chlorinated aromatic compounds in filter deposits of an incinerator plant for radioactive waste. Pt. 1. Analysis of chlorinated polycyclic aromatic compounds.** Tausch, H.; Stehlik, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 26p. (In German). (BL—595/86). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

Limited distribution.

Filter deposits of an incinerator plant for radioactive waste were investigated for their organic components. The concentrated Soxhlet extracts of the deposits were separated by gas chromatography. Detection was performed by an electron capture detector (ECD) connected in series to a flame ionization detector (FID). For compound identification the samples were analyzed in addition by combined gas chromatography/mass spectrometry (GS/MS). Besides polycyclic aromatic hydrocarbons (PAHs) and a few polycyclic heteroaromatics (N-, S-, O-PACs) relative high concentrations of chlorine compounds were found. These about 30 partly isomeric derivatives of a few parent PAHs had up to 4 chlorosubstituents. The reference substances necessary to verify the interpretation of the mass spectra were prepared by catalytic chlorination of the parent PAHs.

23076 **(OEFZS-A—0910) Occurrence of chlorinated aromatic compounds in filter deposits of an incinerator plant for radioactive waste. Pt. 3. Determination of tetrachlorinated dibenzo-p-dioxines.** Tausch, H.; Stehlik, G.; Kainzbauer, J.; Puehringer, M. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 11p. (In German). (BL—598/86). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

Limited distribution.

Filter deposits of an incinerator plant for radioactive waste containing considerable amounts of chlorinated PAHs (56 μg/g) were analyzed for tetrachlorinated dibenzo-p-dioxines (TCDDs). 2.3 ng/g 2,3,7,8-TCDD and a total TCDD amount of 12.0 ng/g were found. These concentrations are in the same range as published for fly ash samples on municipal incineration plants.

23077 (ORNL—6353, pp 40-42) **X-ray diffraction.** Wei, C.H. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

X-ray diffraction was used to determine the molecular structure of four different molecules. Attempts to crystallize the methanesulfonate salt of an antischistosomal drug, IA-4N-oxide, have led to an accidental preparation of yellowish thin-plate crystals which are monoclinic with space group C2/m and Z = 4. The results showed that the compound was the ammonium salt of methanesulfonic acid. A compound, $C_{10}H_8N_2S_8$, was crystallized from a solution of 1:1 mixture of toluene and chloroform at -16 degrees centigrade. In an attempt to prepare cadmium-UMP complex, $Cd(NO_3)_2$ was reacted with Na_2(5'-UMP). The product obtained was [$C_5H_6N^+$.Cd_2Cl_5-]/sub n/ which crystallizes with two basic formula species in an orthorhomibic unit cell of symmetry Pmnm. The anal-

ysis of crystals of 6,7-dihydro-3-methyl-2-one pyrimido[5,4-b][1,4]thiazine-7-carboxylic acid revealed that the molecule possesses a zwitterion structure and the molecular formula is $C_8H_9N_3S.xH_7O$, where x = 0.857 (8).

23078 **(VTT-TUTK—437) Determination of metallic impurities in uranium through anion exchange separation and neutron activation analysis.** Rosenberg, R.J.; Forsbacka, A.M.; Gras, N. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750891.

The separation of metals from uranium by anionic exchange was studied. The behaviour of ions in Dowex 1 x 8 in HNO/sub 3/, H/sub 2/SO/sub 4/, HCl, HCL-HF, and NH/sub 3/ media and Dowex 2x8 in H/sub 2/SO/sub 4/ medium were investigated. Methods for the separation of Na, Mg, Al, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Zr, Ag, Cd, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Yb, La, Hf and Th were developed. For Mo, partial separation was obtained. Separation schemes for the neutron activation analysis of metallic impurities in uranium are proposed. The detection limits are given. The results for the elements Al, Cr, Mn, Co, Ni, Cu, V and Fe determined from the IAEA reference samples SR-54/64 are compared with recommended values.

23079 **Extended luminescence calibration curves for studying surface interactions in solid-surface luminescence analysis.** Burrell, G.J.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **59**: No. 7, 965-970(1 Apr 1987). Contract AC02-80ER10624;FG02-86ER13547.

Calibration curves extended well beyond the normal linear range for solid-surface fluorescence and solid-surface phosphorescence showed some unique characteristics for benzo[f]quinoline adsorbed on a silica chromatoplate under neutral and acidic conditions. The solid-surface fluorescence curves leveled off, whereas the solid-surface phosphorescence curves passed through a maximum and then decreased. The extended calibration curves combined with fluorescence and phosphorescence spectra and phosphorescence lifetimes for benzo[f]quinoline revealed differences in the fluorescence and phosphorescence phenomena. It was determined that fluorescence could occur from molecules adsorbed on the surface and in multilayers of molecules while phosphorescence only occurred from molecules adsorbed on the surface of the chromatoplate and not in the multilayers.

23080 **Direct determination of polycyclic aromatic hydrocarbons in extracts of particulate matter.** Elsaid, A.E.; D'Silva, A.P.; Fassel, V.A.; Dobson, R.L.M. (Iowa State Univ., Ames). *Analytical Chemistry;* **59**: No. 7, 970-973(1 Apr 1987). Contract W-7405-ENG-82.

Laser-excited Shpol'ski spectrometry has been utilized for the direct determination of polycyclic aromatic hydrocarbons (PAH) in high-temperature extracts of particulate matter. Quantitative data on seven PAH present in two national Bureau of Standards standard reference materials (SRM 1649 and 1650) are reported.

23081 **Osmium isotopic ratio measurements by inductively coupled plasma source mass spectrometry.** Russ, G.P. III; Bazan, J.M.; Date, A.R. (Lawrence Livermore National Lab., CA). *Analytical Chemistry;* **59**: No. 7, 984-989(1 Apr 1987). Contract W-7405-ENG-48.

The isotopic composition of nanogram quantities of osmium was measured by using an inductively coupled plasma source mass spectrometer. Sensitivity was enhanced a factor of ~100 by the use of an osmium tetraoxide vapor generator rather than nebulization of solution. For samples ≤5 ng, the ratios $^{190}Os/^{192}Os$, $^{189}Os/^{192}Os$, and $^{188}Os/^{192}Os$ were determined to better than +/- 0.5% (1σ/sub m/) precision. For the minor isotopes, the ratios $^{187}Os/^{192}Os$ and $^{186}Os/^{192}Os$ were determined to +/-1%, and $^{184}Os/^{192}Os$ (4×10^{-4}) was determined to ~10%. Isotope ratios for common osmium are reported.

23082 **Method for determination of oxygen-18 of hydrogen peroxide in rainwater.** Holt, B.D.; Kumar, R. (Argonne National Lab., IL). *Analytical Chemistry;* **59**: No. 7, 995-999(1 Apr 1987).

An analytical method was developed for the determination of $\sigma^{18}O$ of H_2O_2 in rainwater to facilitate isotopic assessment of the relative importance of H_2O_2 in oxidative processes in the atmosphere by which SO_2 is transformed into SO_4^{2-}. By this method, 20-L samples in rainwater, acidified with H_2SO_4 and refrigerated at ~5 °C until time of analysis, were filtered; quantitatively degassed of dissolved air by a combination of evacuation, ultrasonic agitation, and helium sparging (VUS); and treated with pulverized crystals of $KMnO_4$. The O_2, produced by the $KMnO_4$ oxidation of H_2O_2 in the water, was removed from solution by the VUS treatment, converted to CO_2 in the helium stream, and cryogenically separated for subsequent measurements of concentration and $\sigma^{18}O$ of the H_2O_2 in the rainwater. Isotopic results obtained on the H_2O_2, SO_4^{2-}, and H_2O of rainwater samples from Illinois, Michigan, New York, and North Carolina, during the summer of 1985, indicate that 40% or more of the sulfate in precipitation was formed by H_2O_2 oxidation of SO_2 in the atmosphere.

23083 **Optical activity and ultraviolet absorbance detection of dansyl L-amino acids separated by gradient liquid chromatography.** *Analytical Chemistry;* **59**: No. 7, 1059-1061(1 Apr 1987). Contract W-7405-ENG-82.

Many scientific investigations (e.g., geochronology, pharmaceuticals) have the need to determine enantiometric ratios of amino acids and other compounds. It has been reported that OA/UV or OA/RI (refractive index) are ideal methods for the determination of enantiomeric ratios without the need for chiral columns, chiral eluents, or diasteromer preparation. Unfortunately, only three amino acids are naturally UV absorbing (254 nm), and RI sensitivity for amino acids is low. Derivatization by several methods (o-phthalaldehyde, dansyl, phenylisothiocyanate, fluorescamine, 2,4-dinitrofluorobenzene, and phenylthiohydantoin) renders all amino acids UV absorbing and makes UV or fluorescence viable techniques for amino acids determinations. A previously neglected aspect of derivatization is the effect on optical activity. These highly polar groups influence the chiral center of amino acids drastically (electronic and steric effects). The shifting of the absorption band to the proximity of the wavelength used for OA measurements further enhances the importance of the substituent. The authors report here the determination of 17 dansyl amino acids in a mixture by UV absorbance and optical activity. This involves gradient elution. Previously, the optical activity detector (OAD) has been used only with isocratic HPLC.

23084 **Enhancement of osmium detection in inductively coupled plasma atomic emission spectrometry.** Bazan, J.M. (Lawrence Livermore National Lab., CA). *Analytical Chemistry;* **59**: No. 7, 1066-1069(1 Apr 1987). Contract W-7405-ENG-48.

Use of ^{187}Re as a cosmochronometer has been investigated primarily by Luck et al. As part of a project to develop ^{187}Re-^{187}Os chronometry, it became necessary to develop a method for the determination of nanogram quantities of osmium. The instability of osmium in various chemical environments limited the type of separation and purification chemistry that could be used. Previously reported osmium detection limits obtained in inductively coupled plasma atomic emission spectrometry (ICP-AES) vary from 38 ng/mL to 1 μg/mL (8-10). This variation was generally attributed to the unexplained chemical behavior of osmium. Summerhays et al. observed, when using nebulization, that the signal intensity of osmium increased with time in 9 M HNO_3. They attributed this rise in intensity to the formation in solution of the volatile species OsO_4. The signal intensity did not reach a stable value over the period of investigation. The authors decided to take advantage of the volatility of OsO_4 and to introduce it directly into the plasma torch. A stable, enhanced signal for OsO_4 was achieved after identifying (1) a stable matrix solution, (2) an efficient oxidant, (3) the ideal temperature for the reaction, and (4) the optimum instrumental operating parameters.

23085 **Solid-state oxygen-17 nuclear magnetic resonance spectroscopic studies of alkaline earth metasilicates.** Timken, H.K.C.; Schramm, S.E.; Kirkpatrick, R.J.; Oldfield, E. (Univ. of Illinois, Urbana). *Journal of Physical Chemistry;* **91**: No. 5, 1054-1058(26 Feb 1987). Contract FG22-83PC60779.

The authors have obtained high-field (11.7 T, 67.8 MHz) ^{17}O nuclear magnetic resonance (NMR) spectra of a series of alkaline earth metasilicates (clinoenstatite, $MgSiO_3$; diopside, $CaMgSi_2O_6$; pseudowollastonite, α-$CaSiO_3$; strontium metasilicate, α-$SrSiO_3$; and barium metasilicate, $BaSiO_3$). Values of the nuclear quadrupole coupling constants (e^2qQ/h), electric field gradient tensor asymmetry parameters (eta), and isotropic chemical shifts (δ/ sub i/) have been deduced for all the types of oxygen sites encountered. The e^2qQ/h values for the nonbridging oxygens (Si-O-M, M = divalent cation) are in the range 1.6-3.2 MHz and increase with increasing cation electronegativity, the asymmetry parameters vary from 0 to 0.1, and the isotropic chemical shifts become more deshielded with increasing cation radius. The total range of isotropic chemical shifts for the nonbridging oxygens is 127 ppm. For the bridging oxygens (Si-O-Si) in the metasilicates, the e^2qQ/h values are in the range from 3.7 to 5.1 MHz and the asymmetry parameters vary from 0.2 to 0.4. The isotropic chemical shifts again become more deshielded with increasing cation radius, the total range of isotropic chemical shifts being 25 ppm. The chemical shifts for both bridging and non-bridging oxygens in metasilicates indicate that deshielding may be correlated with the presence of large cations, as found previously for ^{17}O NMR spectra of the group IIA (2) and group IIB (12) oxides.

23086 **CCD-based synchrotron X-ray detector for protein crystallography - Performance projected from an experiment.** Strauss, M.G.; Naday, I.; Sherman, I.S.; Kraimer, M.R.; Westbrook, E.M. (Argonne National Lab., Argonne, IL 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 389-395(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

The intense x radiation from a synchrotron source could, with a suitable detector, provide a complete set of diffraction images from a protein crystal before the crystal is damaged by radiation (2-3 min). An area detector consisting of a 40 mm dia. x-ray fluorescing phosphor, coupled with an image intensifier and lens to a CCD image sensor, was developed to determine the effectiveness of such a detector in protein crystallography. The detector was used in an experiment with a rotating anode x-ray generator. Diffraction patterns from a lysozyme crystal obtained with this detector are compared to those obtained with film. The two images appear to be virtually identical. The flux of 10/sup 4/ x-ray photons/s was observed on the detector at the rotating anode generator. At the 6Ge-V synchrotron being designed at Argonne, the flux on an 80 x 80 mm/sup 2/ detector is expected to be > 10/sup 9/ photons/s. The projected design of such a synchrotron detector shows that a diffraction-peak count > 10/sup 6/ could be obtained in —0.5 s. With an additional —0.5 s readout time of a 512 x 512 pixel CCD, the data acquisition time per frame would be —1 s so that ninety 1° diffraction images could be obtained, with approximately 1% precision, in less than 3 min.

23087 **Laser diagnostics for chemical vapor deposition.** Breiland, W.G.; Coltrin, M.E.; Ho, P. (Sandia National Labs., Albuquerque, NM). pp 92 of Digest of technical papers from the OSA/IEEE 1985 conference on lasers and electro-optics. Washington, DC; Optical Society of America (1985). (CONF-850558—).

From Conference on lasers and electro-optics; Baltimore, MD, USA (21 May 1985).

The chemical vapor deposition (CVD) process is used extensively by industry to produce thin films for microelectronics and for wear/corrosion-resistant film applications. The specific methods for producing such films have been developed empirically, and until recently very little basic research has been done on the fundamental physics and the chemistry of the CVD process. This paper describes a coordinated experimental and theoretical program that investigates the gas phase in CVD in detail. Laser techniques offer a unique advantage in CVD diagnostic research because they are nonintrusive and can simultaneously offer selectivity, sensitivity, and high spatial resolution. The authors have used various laser techniques to measure reactant and intermediate chemical species concentrations and gas temperatures and velocities and to monitor particulate formation in a CVD reactor.

23088 **Combination of inadequate and carbon-13 saturation for spectral simplification.** Unkefer, C.J.; Earl, W.L. (Los Alamos National Lab., NM). *Journal of Magnetic Resonance;* **61**: 343-348(1985).

In order to simplify NMR spectra, a variety of two-dimensional techniques including two-dimensional Fourier transform, multiple quantum, and relayed magnetization have been developed and applied. An experiment using INADEQUATE is described herein. The technique was used to interpret the spectra of ^{13}C-enriched L-glutamate. This pulse sequence technique is useful in metabolism and biosynthesis problems. 24 references, 4 figures.

23089 **Lanthanum and silver nitrate mixed titrants laid to rest.** Selig, W.S. (Lawrence Livermore National Lab., CA). *Microchemical Journal;* **31**: 130-131(1985). Contract W-7405-ENG-48.

A pyrolytic graphite sensor conditioned in neutral permanganate and previously reported has been used in a study of the titration of all four halogens in a single titration with a mixed titrant of lanthanum (II) and silver nitrates. This sensor was found to be able to differentiate F^- and total X^- but could not differentiate between the individual X^- components. It is then concluded that two titrations are required to resolve all four halogens with a mixed titrant: one using a platinum sensor to resolve the individual X^- components and a second using a pyrolytic graphite sensor to determine total X^-. 3 references, 1 table.

23090 **A comparison of XEDS and EELS with the use of conventional beryllium window and windowless Si(Li) detectors.** Zaluzec, N.; McConville, R.; Sandborg, A. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). pp 348-352 of Analytical electron microscopy. Williams, D.B.; Joy, D.C. San Francisco, CA; The San Francisco Press Inc. (1984). (CONF-840767—).

From Microbeam Analysis Society analytical electron microscopy meeting; Bethlehem, PA, USA (16 Jul 1984).

The use of electron energy loss spectroscopy (EELS) for light-element identification is now a well-established technique. Although not a new concept, modified Si(Li) detectors with the conventional beryllium window replaced by a ultra-thin aluminum-coated parylene window (UTW), or with the beryllium completely removed for windowless (WL) operation, have now become routinely available. Since both systems can now be easily interfaced to modern analytical electron microscopes (AEMs) it becomes relevant to determine experimentally the relative merits of the two different techniques for light-element identification and subsequent quantification in both simple systems and complex materials problems, such as precipitate identification in multicomponent alloys. In this preliminary study, the authors have systematically studied the relationship between EELS and XEDS (using a WL detector) for elements ranging from lithium through gallium, with the exception of neon and argon, as well as typical problems in precipitate analysis in thermally aged 316 stainless steel specimens.

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REFER ALSO TO CITATION(S) 22105, 22132, 22148, 22149, 22187, 22294, 22898, 23021, 23070, 23071, 23088, 23088, 23147, 23147, 23148, 23161, 23397, 23538

23091 **(AD-A—175649/3/XAB) Studies on deuteration of fused silica. Final report, 15 October 1983-14 October 1986.** Kumar, B. (Dayton Univ., OH (USA). Research Inst.). 17 Nov 1986. 34p. NTIS, PC A03/MF A01.

The isotope-exchange reactions between hydrogen and deuterium in vitreous silica, microcover borosilicate and NBS 710 glasses has been investigated. The exchange reaction shifts the hydroxyl absorption bands to longer wavelengths by a factor of approx 1.35. The extinction coefficient of the OD group was determined are 36.7 and 56.3 kJ/mol for hydrogenation and deuteration reactions, respectively. The two reactions have been shown to be irreversible which has been explained on the basis of differences in permeability and diffusion of hydrogen and deuterium gases, as well as on the chemical nature of OH and OD groups. The relevance of the irreversible nature of the two reactions in suppressing transmis-

sion losses in optical fibers is discussed. The pressure dependence of the exchange reactions in microcover borosilicate and NBS 710 color centers in the NBS 710 glass is proposed to be related to the formation of FeS.

23092 **(CONF-870254—1) A microcrystalline growth study of solvent effects in alkoxides by dynamic laser light scattering.** Byers, C.H.; Harris, M.T. (Oak Ridge National Lab., TN (USA)). Feb 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02. File Number DE87005710.

From 3. international conference on ultrastructure processing of ceramics, glasses, and composites; San Diego, CA, USA (23 Feb 1987).

The hydrolysis and condensation reactions which result in homogeneous precipitation of alkoxides, such as silicon ethoxide, are studied in laser light scattering facility in which a thermally-controlled quartz cell is used as a crystallization vessel. Rapid, non-intrusive monitoring of the growth of the particles in 0.005-to-1 micron range is achieved. A study of particle growth and powder characteristics of the titania and silica indicates that a major contributing factor to the ultimate particle size and morphology is the nature of alcohol solvent medium for the reaction. Results for ethanol propanols and three butanols indicate that particle characteristics are improved by choosing the proper solvent. 21 refs., 7 figs.

23093 **(CONF-8609132—13) Two-color, Doppler-free ionization of molecular hydrogen for isotopic analysis.** Hessler, J.P.; Glab, W.L. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004975.

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Although resonant ionization techniques have been applied to many atomic systems for ultrasensitive isotopic analysis, very little work has been done on even the simplest molecular system, molecular hydrogen, and its isotopic variants; deuterium hydride, tritium hydride, molecular deuterium, tritium deuteride, and molecular tritium. We present a three-step ionization scheme which will selectively ionize any isotopic variant. The projected isotopic selectivity is sufficient to detect tritium hydride at ambient concentrations without the need of mass analysis. The efficiency of the ionization process is high enough to allow work on small samples. This technique can be applied to many areas of research, e.g., isotopic exchange reactions in the atmosphere and isotopic effects on surfaces. The physical mechanisms which govern the conflicting objectives of both high isotopic selectivity and detection efficiency, discussed below, can be applied to any molecular system. 2 refs., 4 figs., 1 tab.

23094 **(DOE/PC/90911—3) Simple method for the synthesis of perdeuterated aromatic hydrocarbons and heterocyclic compounds.** Hawthorne, S.B.; Miller, D.J.; Aulich, T.R.; Farnum, S.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1987. Contract FG22-86PC90911. 8p. (CONF-870410—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002296.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

A general method has been developed for the preparation of deuterated aromatic compounds that are useful for coal reaction studies and as internal standards for GC/MS analysis. The method requires little specialized equipment or synthesis expertise. A reaction mixture containing DCl, D_2O, and chromium is used to exchange deuterium for aromatic hydrogens at temperatures of 200 to 300°C. A single set of reaction conditions can be used to prepare a wide range of deuterated aromatics with nearly complete exchange of aromatic hydrogen for deuterium and little or no chemical degradation of the reactant. When a 20:1 molar ratio of deuterium to aromatic hydrogen was used the isotopic purity of most species tested including phenanthrene (isotopic purity of 94%), pyrene (95%), phenol (96%), dibenzofuran (96%), carbazole (94%), and dibenzothiophene (93%), approached the H/D exchange equilibrium of 95% in two to fifteen hours. The method also works well with complex mixtures as demonstrated by the deuteration of aromatics in a coal-derived anthracene oil. 6 refs., 2 figs., 1 tab.

23095 **(EPRI-EL/EA—4858-Vol.3) Polychlorinated dibenzofurans (PCDF) and polychlorinated dibenzo-p-dioxins (PCDD) in utility transformers and capacitors: Volume 3, Final report.** Nichols, A.W.; Kilpatrick, M.P.; Hardin, E.D.; Hayes, D.A. (Radian Corp., Austin, TX (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 215p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920287.

Many health effects originally attributed to PCBs appear to result from their pyrolysis and combustion by-products, PCDF and PCDD. This study developed improved techniques for characterizing these products and showed that PCDF and PCDD do not form during catastrophic arcing failure in transformers and capacitors. This volume includes a report on synthesis of new PCDF spiking compounds.

23096 (IA—1421, pp 64) **Neutron diffraction investigation of commensurate and incommensurate phases in UAssub(1-x)Sesub(x) single crystals.** Kuznietz, M.; Burlet, P.; Rossat-Mignod, J.; Vogt, O. (Israel Atomic Energy Commission, Tel Aviv; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Eidgenoessische Technische Hochschule, Zurich, Switzerland). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23097 (IA—1421, pp 65) **Neutron diffraction study of UAssub(0.95)Sesub(0.05) single crystal. Disappearance of the type-I antiferromagnetic structure.** Kuznietz, M.; Burlet, P.; Rossat-Mignod, J.; Vogt, O. (Israel Atomic Energy Commission, Tel Aviv). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23098 (IA—1421, pp 65-66) **Neutron diffraction study of a NpAs single crystal.** Burlet, P.; Quezel, S.; Bonnisseau, D.; Rossat-Mignod, J.; Kuznietz, M.; Spirlet, J.C.; Rebizant, J.; Vogt, O. (CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Israel Atomic Energy Commission, Tel Aviv; European Institute for Transuranium Elements, Karlsruhe, Germany, F.R.). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23099 (IA—1421, pp 66-67) **Magnetic phase diagram of the UAssub(1-x)Sesub(x) system in zero magnetic field studied by neutron diffraction from single crystals.** Kuznietz, M.; Burlet, P.; Rossat-Mignod, J.; Vogt, O. (Israel Atomic Energy Commission, Tel Aviv; Eidgenoessische Technische Hochschule, Zurich, Switzerland). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23100 (IA—1421, pp 67-68) **Neutron diffraction and magnetization studies of UPsub(0.80)Ssub(0.20) single crystals. Observation of several incommensurate and field-induced ferrimagnetic phases.** Kuznietz, M.; Burlet, P.; Rossat-Mignod, J.; Vogt, O.; Mattenberger, K. (Israel Atomic Energy Commission, Tel Aviv; Eidgenoessische Technische Hochschule, Zurich, Switzerland). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23101 (INIS-mf—10573, pp 17-20) **Chemistry of complex uranium compounds.** Baran, V. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701488. (CONF-8506335—Pt.3).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

A survey is presented of knowledge acquired and results achieved by UJV in the field of uranium chemistry for coping with the technology of nuclear fuel preparation, i.e., preparation of UO/sub 2/ pellets or fuel spheres prepared by the sol-gel process. The chemistry is discussed of the wet conversion of UF/sub 6/ to uranium dioxide. The possibilities are dealt with of displacing fluorine from the uranyl fluoride complex as well as methods of uranyl extraction and re-extraction. Data are presented on the structure of the uranyl bond in hydroxocomplexes. (E.S.).

23102 (INIS-mf—10573, pp 35-38) **Possible uses of inorganic adsorbents in nuclear power engineering.** Franta, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701488. (CONF-8506335—Pt.3).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

A survey is presented of the research results of selected inorganic adsorbents available in Czechoslovakia. The research was carried out at UJV Rez with the aim of finding suitable applications of these adsorbents to the decontamination of liquid media and wastes from Czechoslovak nuclear power installations. Several examples are given to show the use of inorganic adsorbents abroad. Of the studied adsorbents, synthetic modernite was chosen which was investigated with regard to the removal of cesium radioisotopes from the coolant of the spent fuel transport and storage tank, further hydrated titanium dioxide for trapping Sr, Co and Mn from liquid media containing boric acid and borates, and natural clinoptilolite and mordenite for removing cesium from liquid wastes from special laundries of WWER nuclear power plants.

23103 (INIS-mf—10577, pp 54) **Studies on new titanium ferrocyanide sorbents for radiocaesium removal from primary coolants of pressurized water reactors.** Narbutt, J. (Institute of Nuclear Chemistry and Technology, Warsaw, Poland. Department of Chemistry). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23104 (INIS-mf—10577, pp 55) **Porous sorbents and membrane supported specific actinide chelators and solvent extractants.** Navratil, J.D. (Rockwell International Corp., Golden, CO, USA). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23105 (INIS-SU—401, pp 60-63) **In-Te chemical bond in crystal lattice of Pbsub(0,78)Snsub(0,22)Te<In>.** Aleksandrov, O.V.; Kiseleva, K.V.; Kuchaev, S.D. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.
In Experimental and theoretical physics. Collection.

Using the Auger electron spectroscopy method it is found that in Pbsub(0.78)Snsub(0.22)Te < In > solid solutions at 0.7-0.9 at.% indium critical concentration a variation of type of indium chemical bond with surrounding lattice from predominantly ionic to predominantly covalent one takes place, at that Insup(3+) charge state being retained.

23106 (INR—1938/14/PS/A) **Studies of the structure of pseudobinary R/sub 2/(Co,M)/sub 17/ and R/sub 2/(Fe,M)/sub 17/ compounds.** (Institute of Nuclear Research, Warsaw (Poland)). 1982. 30p. Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

The unit cell constants of pseudobinary rare earth-cobalt compounds R/sub 2/(Co,M)/sub 17/ were measured for R = Gd, Sm and Y, M = Mn, Al and Cu. The homogeneity ranges of these compounds are compared with the previously reported results concerning similar compounds of other rare earths. The effort was made to show the influence of the atomic size of the substituting M atoms on the unit cell volume. The magnetic domain structure of R/sub 2/(Co,Mn)/sub 17/ compounds is presented. The attempts to prepare single phase Dy/sub 2/(Fe,M)/sub 17/ for M = Cu,Ni and B are reported.

23107 (INR—1946/14/PS/A) **Size effects of RM/sub 5/ and R/sub 2/M/sub 17/ intermetallic compounds.** (Institute of Nuclear Research, Warsaw (Poland)). 1982. 42p. Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland.

The correlation between the metallic radius and the ionic radius is used to modify the values of the metallic radii of the rare earth elements. The linear relations between the unit cell dimensions of RM/sub 5/ and R/sub 2/M/sub 17/ compounds and the size of rare earth atoms are observed. The exceptions from the linear rules due to the mixed valency and to the off-stoichiometric composition are discussed.

23108 (LBL—22534) **A kinetic and thermodynamic study of the reversible C-H insertion/elimination of alkanes at iridium.** Buchanan, J.M. (California Univ., Berkeley (USA)). Sep 1985. Contract AC03-76SF00098. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87004599.

The following areas of research are reported: kinetics of the thermolysis of a hydridocyclohexyliridium(III) complex $Cp(PMe_3)Ir(Cy)(H)$ (where $Cp = \eta^5\text{-}C_5Me_5$ and Cy = cyclohexyl) in benzene: the mechanism of thermal C-H insertion/elimination; an equilibrium study of reversible alkane C-H insertion/elimination; the synthesis of (η^5-cyclopentadienyl)-(trimethylphosphine)dihydridoiridium(III) and its use in the preparation of hydridoaryl and hydridoalkyl complexes.

23109 (ORNL/TM—10258) **Thermodynamic properties of aqueous ternary solutions relevant to chemical heat pumps: Final report.** Ally, M.R. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007799.

Polynomial expressions are developed that correlate experimental vapor-liquid-equilibrium (VLE) and specific enthalpy concentration data for a newly developed ternary absorption fluid ($LiNO_3$-KNO_3-$NaNO_3$). The development of these expressions are an important step toward using existing ORNL computer software to evaluate heat pump performance. A canned least-square-fit program, POLFIT.BAS, was invoked to obtain the polynomial coefficients. Results show that the maximum deviation between correlated and actual values is less than 3% for vapor pressure and enthalpy. This is considered sufficiently accurate for heat pump cycle performance studies.

23110 (PB—87-140497/XAB) **Structure-reactivity relationships for predicting environmentally hazardous chemicals. Final report, 1983-1986.** Cohen, N. (University of Southern California, Los Angeles (USA)). Dec 1986. 50p. NTIS, PC A03/MF A01.

A method for extrapolating rate coefficients using transition-state theory was applied to reactions of hydroxyl (OH) radicals with 10 halomethanes and 18 haloethanes. The entropy of activation was calculated for each compound and together with an experimental value of the rate of reaction at 298 K was used to calculate k(T) at higher temperatures. The calculated values for all the haloalkanes differed from experimental values by no more than 25%, except that of OH + $CHCl_3$. For most haloalkanes this expression predicts rate coefficients within a factor of 3 of experimental data and provides a useful predictive tool if no reliable data are available.

23111 (SAND—86-8244) Modeling of temporal behavior of isotopic exchange between gaseous hydrogen and palladium hydride power. Melius, C.F.; Foltz, G.W. (Sandia National Labs., Livermore, CA (USA)). Jan 1987. Contract AC04-76DR00789. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007162.

A parametric rate-equation model is described which depicts the time dependent behavior of the isotopic exchange process occurring between the solid and gas phases in gaseous hydrogen (deuterium) flows through packed-powder palladium deuteride (hydride) beds. The exchange mechanism is assumed to be rate-limited by processes taking place on the surface of the powder. The fundamental kinetic parameter of the model is the isotopic exchange probability, p, which is the probability that an isotopic exchange event occurs during a collision of a gas phase atom with the surface. Isotope effects between the gas and solid phases are explicitly included in terms of the isotope separation factor, α. Results of the model are compared with recent experimental measurements of isotope exchange in the β-phase hydrogen/palladium system and, using a literature value of $\alpha = 2.4$, a good description of the experimental data is obtained for $p \sim 10^{-7}$. In view of the importance of the isotope effects in the hydrogen/palladium system and the range of α values reported for the β-phase in the literature, the sensitivity of the model results to a variation in the value of α is examined.

23112 (SAND—87-0218C) Kinetics of HCPB [bis-Hydroxycyclobutadiyne] diffusion in Sylgard. Renschler, C.L.; Gillen, K.T.; Keenan, M.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-870482—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005844.

From 14. Department of Energy compatibility, aging and service life conference; Amarillo, TX, USA (28 Apr 1987).

Diffusion of HCPB away from a Pd catalyst results in loss of efficiency as a hydrogen getter. It is of interest to measure the diffusion rate of HCPB through Sylgard 1984 silicone rubber. This report describes the technique of density profiling to acquire this information. (JDH)

23113 Triplet (T_1) state resonance Raman spectroscopy of some azanaphthalenes. Kessler, R.J.; Tripathi, G.N.R. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *Journal of Chemical Physics;* **86**: No. 8, 4347-4352(15 Apr 1987).

The time-resolved T/sub n/←T_1 resonance Raman spectra of quinoline (1-azanaphthalene), isoquinoline (2-azanaphthalene), quinoxaline (1,4-diazanaphthalene), and quinazoline (1,3-diazanaphthalene) molecules in cyclohexane solution are reported, and vibrational assignments and structural implications are discussed. In each of the four compounds, the most resonance enhanced Raman band lies in the 1340-1270 cm^{-1} region and corresponds to nuclear displacements involving in-plane stretching motions of the CC and CN bonds. In diazanaphthalenes, drop in the frequency of this vibration on S_0 to T_1 excitation (97 cm^{-1} in quinoxaline, 76 cm^{-1} in quinazoline) is observed to be higher than in azanaphthalenes (31 cm^{-1} in quinoline, 58 cm^{-1} in isoquinoline) implying pronounced elongation of the CN bonds, in comparison to the CC bonds, in the T_1 states. The T_1 Raman spectra of azanaphthalenes, in contrast to naphthalene, are observed to exhibit significant solvent dependency.

23114 Composite desiccant structure. Fraioli, A.V.; Schertz, W.W. (to Dept. of Energy, Washington, DC). US Patent 4,645,519. 24 Feb 1987. Filed date 30 Dec 1985. vp.

This patent describes a composite useful for dehumidifying purposes and comprising a matrix of a porous binder as a solid web containing a transition metal oxide having internal surfaces defining pores and a plurality of desiccant particles embedded in the matrix. The desiccant particles have diameters in the range of about 1-300 μm, constituting a major portion of the composite and are selected from the group consisting of silica gel, zeolite, alumina, activated carbon and mixtures thereof, the composite being in sheet-like form with exterior surfaces, a portion of the particles being below the exterior surfaces and covered by other particles. The transition metal oxide in the web is capable of transmitting moisture along the pore surfaces between desiccant particles and between the exterior surfaces and the desiccant particles.

23115 Uptake of ammonia by iron clusters: A new procedure for the study of metal cluster chemistry. Parks, E.K.; Nieman, G.C.; Pobo, L.G.; Riley, S.J. (Chemistry Division Argonne National Laboratory, Argonne, IL 60439). *Journal of Chemical Physics;* **86**: No. 2, 1066-1067(15 Jan 1987). Contract W-31-109-ENG-38.

A new procedure is described for the study of chemical reactions of metal clusters with simple gas phase molecules. It consists of determining the average number of reagent molecules taken up by the clusters as a function of reagent pressure over a very wide range of pressures. When the results of such experiments are appropriately analyzed, they provide information on cluster reaction kinetics, thermodynamics, and the composition of reaction products. An illustration of this procedure for the reaction of iron clusters with ammonia is presented.

23116 Oxidation of uranium-0.75wt% titanium in environments containing oxygen and/or water vapor at 140/sup 0/C. Greenholt, C.J.; Weirick, L.J. (Sandia National Labs., Albuquerque, NM, USA). *Journal of Nuclear Materials;* **144**: No. 1/2, 110-120(Jan 1987). Contract AC04-76DP00789.

This research addressed the oxidation behavior of uranium-0.75 wt% titanium (U-0.75Ti) in environments containing oxygen and/or water vapor at 140/sup 0/C and compared it with that of unalloyed uranium. The alloy reacts with water vapor to form uranium dioxide and hydrogen with the reaction kinetics proportional to the water vapor pressure to the 1/2.1 power. U-O.75Ti reacts with oxygen to form uranium dioxide. The reaction rate is linear and independent of the oxygen pressure between 0.067 and 133.3 kPa and it was approximately 3.2 x 10/sup -3/ mg/cm/sup 2/xh. In a mixed environment of oxygen and water vapor, the alloy reacts preferentially with the oxygen at a linear rate of approximately 3.3 x 10/sup -3/ mg/cm/sup 2/xh until the oxygen is depleted. After the oxygen is consumed, the reaction and kinetics change to those of the alloy/water reaction. Unalloyed uranium behaves similarly to the alloy in all three environments, however, an initial region of water vapor/uranium reaction was observed in the mixed environment which was not seen in the alloy studies.

23117 Synthesis, characterization, and electrochemical studies of iron, cobalt, and nickel complexes of polyphosphine ligands. DuBois, D.L.; Miedaner, A. (Solar Energy Research Institute, Golden, CO). *Inorganic Chemistry;* **25**: No. 26, 4642-4650(17 Dec 1986).

The reaction of $[M(CH_3CN)_6](BF_4)_2$ (where M = Fe, Co, and Ni) with $P(CH_2CH_2PPh_2)_3$ (PP_3), $PhP(CH_2CH_2PPh_2)_2$ (PP_2), and $Ph_2PCH_2CH_2PPh_2$ (dppe) results in the formation of $[Fe(PP_3)(CH_3CN)_2](BF_4)_2$, $[Fe(PP_2)(CH_3CN)_3](BF_4)_2$, $[Fe(dppe)_2(CH_3CN)_2](BF_4)_2$, $[Co(PP_3)(CH_3CN)](BF_4)_2$, $[Co(dppe)_2(CH_3CN)](BF_4)_2$, $[Ni(PP_3)(CH_3CN)](BF_4)_2$, $[Ni(PP_2)(CH_3CN)](BF_4)_2$, and $[Ni(dppe)_2](BF_3)_2$, respectively. Electrochemical studies have been carried out on these complexes to examine the influence of the nature of the polyphosphine ligand on the redox properties of each metal. For $[Fe(PP)(CH_3CN)_2](BF_4)_2$ the reversibility of both the Fe(II/III) and Fe(I/0) couples are enhanced relative to those of $[Fe(dppe)_2(CH_3CN)_2](BF_4)_2$. For $[Co(PP_3)(CH_3CN)](BF_4)_2$ the lowest oxidation state accessible in CH_3CN is +1, while for $[Co(dppe)_2(CH_3CN)](BF_4)_2$ the -1 oxidation state can be observed. The Ni(I/0) couple is reversible for $[Ni(dppe)_2](BF_4)_2$ and irreversible for $[Ni(PP_2)(CH_3CN)](BF_4)_2$ and $[Ni(PP_3)(CH_3CN)](BF_4)_2$. The electrochemical studies of the latter complex have led to the synthesis of a Ni(0) dimer, $[Ni(PP_3)]_2$.

23118 Structural study of the Cu sites in metallothionein from neurospora crassa. Smith, T.A.; Lerch, K.; Hodgson, K.O. (Stanford Univ., CA). *Inorganic Chemistry;* **25**: No. 26, 4677-4680(17 Dec 1986).

The structure of the Cu centers in the low-molecular-weight metallothionein (MT) from Neurospora crassa has been investigated by x-ray absorption edge and extended x-ray absorption fine structure (EXAFS) spectroscopy. Analysis of the EXAFS data by curve-fitting procedures yields results most consistent with an average Cu environment of 3-4 S atoms at 2.20 A, and 1-2 Cu atoms at 2.71 A. Comparison of the Cu-MT x-ray absorption edge with that of a structurally characterized Cu_4S_6 inorganic cluster reveals dis-

tinct similarities, suggesting significant congruence between the protein and the compact cluster structure found in the model. When they are taken together, the edge and the EXAFS data of Cu-MT are most consistent with three- or four-coordinate geometry around Cu and do not support the previously proposed two-coordinate linear-chain structure. 22 references, 4 figures, 1 table.

23119 **Kinetics of acid hydrolysis of the nitridotrisulfate ion.** Littlejohn, D.; Wizansky, A.R.; Chang, S.G. (Lawrence Berkeley Lab., CA). *Inorganic Chemistry;* **25**: No. 25, 4610-4611(3 Dec 1986). Contract AC03-76SF00098.

A number of nitrogen sulfonates are produced by reactions between bisulfite ions and nitrite ions in aqueous solution. Thus, their chemistry is of interest in studies of aqueous aerosols in polluted air and in wet flue gas scrubbing systems. The hydrolysis reactions of nitridotrisulfate (NTS) and hydroxysulfamate (HSA), have been thoroughly investigated. Sisler and Audrieth observed the hydrolysis reaction of NTS at several temperatures: $N(SO_3)_3^{3-} + H_2O \rightarrow HN(SO_3)_2^{3-} + H^+ + SO_4^{2-}$. They found that the NTS hydrolysis reaction occurred much more quickly than the iminodisulfate hydrolysis reaction but did not obtain any quantitative results. The authors have studied the hydrolysis of NTS over a temperature range of 283-333 K at solution pHs ranging from 4.1 to 6.7. The influence of ionic strength was determined over a range of $\mu = 0.03$-0.5 M.

23120 **Iron-sulfur bond lengths in ferrous-CO heme complexes as a function of sulfur donor type.** Kau, L.S.; Svastits, E.W.; Dawson, J.H.; Hodgson, K.O. (Stanford Univ., CA). *Inorganic Chemistry;* **25**: No. 23, 4307-4309(5 Nov 1986).

The previously reported work on the determination of the role of sulfur donor ligand in the function of heme proteins is very briefly surveyed. The results of studies in which x-ray absorption fine structure (EXAFS) spectroscopy has been employed for the structural analysis of sulfur-ligated heme complexes are reported. These results substantially expand the data base of Fe(II)-S/sub ax/ bond lengths in ferrous porphyrin complexes. 30 references, 1 table.

23121 **Chemistry and thermodynamics of ruthenium and some of its inorganic compounds and aqueous species.** Rard, J.A. (Lawrence Livermore National Lab., CA). *Chemical Reviews;* **85**: No. 1, 1-39(Feb 1985). Contract W-7405-ENG-48.

Chemical and thermodynamic data for ruthenium and many of its inorganic compounds and aqueous solutions have been critically reviewed. Values for thermodynamic properties are recommended when both the chemistry and thermodynamics are sufficiently well characterized to warrant confidence in them. Systems reviewed included metallic Ru, phase diagrams with metals and non-metals, chalcogenides, oxides, halides, oxyhalides, oxysulfur, and oxynitrogen compounds. Aqueous systems considered are aquo ions, hydrolyzed cations, oxyanions, halide complexes, and sulfate complexes. The oxide, halide, oxyhalide, and aqueous systems (both noncomplexing and complexing media) are described in considerable detail because of their great complexity and because of conflicting claims and questionable analyses in some published reports. Recommendations are made for data that need to be measured or remeasured. 480 references, 1 figure, 9 tables.

23122 **Resonance Raman studies of blue copper proteins: effect of temperature and isotopic substitutions. Structural and thermodynamic implications.** Blair, D.F.; Campbell, G.W.; Schoonover, J.R.; Chan, S.I.; Gray, H.B.; Malmstrom, B.G.; Pecht, I.; Swanson, B.I.; Woodruff, W.H.; Cho, W.K.; English, A.M. (Los Alamos National Labs., NM). *Journal of the American Chemical Society;* **107**: 5755-5766(1985).

Resonance Raman spectra of the single-copper blue proteins azurin plastocyanin and stellacyanin and the multicopper oxidases laccase ascorbate oxidase and cerulo;plasmin are reported. Cryoresonance Raman observations (10-77 K) are reported for selected azurins, stellacyanin, the plastocyanins, and the laccases. Isotope studies employing $^{63}Cu/^{65}Cu$ and H/D substitution are reported for selected azurins and stellacyanin, allowing identification of modes having significant copper-ligand (Cu-L) stretch and internal ligand deformation character. Principal conclusions include the following. The only Cu-L stretching mode near 400 cm^{-1} is the Cu-S(Cys) stretch, and the remainder of the elementary motions near this frequency are internal ligand deformations. All the observed modes near 400 cm^{-1} are highly mixed, and most derive their intensity from their fractional Cu-S(Cys) stretching character. The Cu-N(His) stretching motions are best identified with the ubiquitous peak(s) near 270 cm^{-1}, although in azurin these modes have contributions from other coordinates. Internal histidine and cysteine motions contribute to the features near 400 cm^{-1}. This is consistent with a single resonant electronic chromophore and extremely facile vibrational dephasing or other damping processes in the electronically excited state. Temperature effects upon the spectra suggest a significant temperature-dependent structure change at the plastocyanin active site, and a more subtle one in azurin. It is shown that the Cu-S(Cys) stretching frequency is closely correlated to the electron-transfer exothermicity for several proteins, thereby indicating the reduction potential can be fine tuned by the effects of polypeptide backbone structure on the copper-sulfur bond distance and the copper-ligand field. 41 references.

23123 **Self-diffusion in compressed supercritical toluene-d_8.** Baker, E.S.; Brown, D.R.; Lamb, D.M.; Jonas, J. (Univ. of Illinois, Urbana). *Journal of Chemical and Engineering Data;* **30**: No. 2, 141-143(1985).

The self-diffusion coefficients of supercritical toluene-d_8 were measured by using the NMR spin-echo technique for temperatures from 300 to 450°C at constant pressures of 100, 500, and 1000 bar. The results at 100 bar are compared to the predictions for toluene diffusion by using various empirical correlation methods for estimation of the diffusion coefficients in the supercritical region. 26 references, 2 figures, 2 tables.

23124 **Synthesis and interconversion of the four isomeric 6-oxo-2,4-heptadienoic acids.** Feliu, A.L.; Seltzer, S. (Brookhaven National Lab., Upton, NY). *Journal of Organic Chemistry;* **50**: No. 4, 447-451(1985).

The synthesis of the structural isomers of 6-oxo-2,4-heptadienoic acid was undertaken as a means of providing analogues to investigate the structural requirements of maleylacetone cis-trans isomerase. 6-Oxo-2(Z),4(E)-heptadienoic acid and the methyl esters of 6-oxo-2(E),4(Z)-, 6-oxo-2(Z),4(Z)-, and 6-oxo-2(E),4(E)-heptadienoic acid were synthesized. Base-catalyzed hydrolysis of these esters furnished the corresponding acids except in the case of the 2Z,4Z isomer, which yielded instead the 2Z,4E acid. A mechanism for isomerization is suggested. Photocatalyzed isomerization of the acids and esters as a possible way of generating the ZZ acid was studied. The properties of the acids, their interaction with the enzyme, and what this suggests about the interaction of substrate maleylacetone with the enzyme is discussed. 16 references, 1 figure, 2 tables.

23125 **Quantum ergodicity in small molecules: the continuum fluorescence of nitrogen dioxide.** Hardwick, J.L. (Univ. of Notre Dame, IN). *Journal of Molecular Spectroscopy;* **109**: 85-98(1985).

The failure of selection rules on K/sub a/, nu, and vibronic symmetry in the visible band systems of NO_2 are interpreted as resulting from the coupling of the excited electronic state with vibrational levels of the ground electronic state which are above the threshold for ergodic motion and therefore retain no quantization of those observables. This failure is shown to lead directly to the anomalous continuum fluorescence of NO_2, and is intimately related to the anomalous lengthening of the radiative lifetime of the excited state (the Douglas effect). It is predicted that most molecules which exhibit anomalous lifetime lengthening will also exhibit anomalous selection rules and, consequently, anomalous continuum emission. 51 references, 4 figures.

23126 **Organothorium-nickel phosphido complex with a short Th-Ni distance. Structure of $Th(eta_5\text{-}C_5(CH_3)_5)_2(\mu\text{-}PPh_2)_2Ni(CO)_2$.** Ritchey, J.M.; Zozulin, A.J.; Wrobleski, D.A.; Ryan, R.R.; Wasserman, H.J.; Moody, D.C.; Paine, R.T. (Los Alamos National Lab., NM). *Journal of the American Chemical Society;* **107**: No. 2, 501-503(1985).

The reaction of the complex $ThCp^*_2(PPh_2)_2$ with a variety of transition-metal complexes have been investigated, and the synthesis and structure of the Ni-carbonyl derivatives is reported here. The structural data for the complex suggest a bonding interaction between the thorium and nickel atoms. The molecular structure of Cp^*_2Th (mu-$PPh_2)_2Ni$ (CO) is presented, and the bond lengths and bond angles are reported. Crystal parameters are also reported. It is concluded that there are no structural constraints in the presented structure which dictate a short Th-Ni distance, other than a direct metal-metal interaction. 23 references, 2 figures.

23127 **Potentiometric study of cytochrome c1aa$_3$ from Thermus thermophilus.** Yoshida, T.; Fee, J.A. (Univ. of Michigan, Ann Arbor). *Journal of Inorganic Biochemistry;* **23**: 279-288(1985).

The redox behavior of the cytochrome c_1aa_3 complex from Thermus thermophilus has been examined. In potentiometric titrations the cytochrome c behaves as an independent center having n = 1 and E = 205 mV (NHE). Under the assumption that the individual centers equilibrate independently in this experiment, changes in the absorption band at 603 nm have been resolved into two components: cytochrome a (n = 1, E/sub m/ = 270 mV, 60% spectral contribution) and cytochrome a_3 (n = 2, E/sub m/ = 360 mV, 40% spectral contribution). The n = 2 process was attributed to strong chemical coupling between cytochrome a_3 and Cu/sub B/. The enzyme was also titrated with a mixture of NADH and PMS, and the results are shown not to conform to a model of intramolecular equilibrium according to the equilibrium constants obtained from the potentiometric titration. It is suggested that a conformational equilibrium within the complex may control electron transfer between cytochromes a and a_3. 21 references, 4 figures, 2 tables.

23128 **Studies of carbon- and hydrogen-containing adspecies present during CO hydrogenation over unsupported Ru, Ni, and Rh.** Winslow, P.; Bell, A.T. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **94**: 385-399(1985). Contract AC03-76SF00098.

Isotopic tracer studies have been conducted to determine the coverages of adsorbed CO, carbon and hydrogen on the surfaces of unsupported Ru, Rh, and Ni powders during CO hydrogenation. Two forms of hydrogen are observed on each catalyst at 298 K: a low-energy form which is in equilibrium with the gas phase and is rapidly displaced from the surface by CO adsorption and a high-energy form which is not in equilibrium with the gas phase and is not displaced by CO adsorption. The low-energy form is ascribed to hydrogen adsorbed on the exterior surfaces of the metal powder. It is proposed that the high-energy form may be hydrogen which has migrated along crystal grain boundaries into the interior of the metal powder. Adsorbed carbon and CO are also observed on each catalyst. It is demonstrated that high methanation activity correlates with the surface coverage of active carbon but not with the coverage of adsorbed hydrogen. 51 references, 14 figures, 6 tables.

23129 **Synthesis and reactions of hydrido(eta^1-allyl)- and hydrido(eta^3-allyl)iridium complexes.** McGhee, W.D.; Bergman, R.G. (Univ. of California, Berkeley). *Journal of the American Chemical Society;* **107**: 3388-3389(1985). Contract AC03-76SF00098.

A system is reported in which isolable hydrido σ- and π-allyl complexes can be prepared and their interconversions investigated. These complexes have often been postulated to be used as transient intermediates in organometallic reactions. Various iridium complexes were prepared, and the schemes for their preparation are discussed. In the eta^3-allyl hydride, the reactivity of allyl and hydride ligands leads to coordinated propane and provides an open coordination site for entry of both stabilizing and reactive ligands into the coordination sphere of the metal. The results presented here provide direct support for many alkene activation and isomerization mechanisms that have only been postulated in the past.

23130 **Fluxional behavior in the solid state: bullvalene.** Meier, B.H.; Earl, W.L. (Los Alamos National Lab., NM). *Journal of the American Chemical Society;* **107**: No. 19, 5553-5555(1985).

Results of high-resolution NMR spectral studies of bullvalene are presented. The cross polarization-magic angle spinning ^{13}C spectra of the powder was recorded at 213, 300, and 358 K. The results provide that the Cope Rearrangement takes place in the crystalline solid. The results obtained for the activation enthalpy, as well as the preexponential factor for the Cope Rearrangement, agree closely with the ones reported previously for solution and liquid-crystalline solution. 20 references, 1 figure.

23131 **Theoretical investigation into the nature of the second vertical ionic state of the water dimer.** Curtiss, L.A. (Argonne National Lab., IL). *Chemical Physics Letters;* **112**: No. 5, 409-411(21 Dec 1984).

Ab initio molecular orbital calculations have been carried out to resolve questions concerning the location of the second ionization in the water dimer. The results indicate that it is from the proton acceptor molecule of the water dimer. 13 references, 1 figure.

23132 **Optical and thermal effects in laser chemical vapor deposition.** Allen, S.D.; Jan, R.Y.; Edwards, R.H.; Mazuk, S.M.; Vernon, S.D. (Univ. of Southern California, Univ. Park, Los Angeles). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **459**: 3-9(1984).

In laser chemical vapor deposition (LCVD), a laser is used to drive a deposition reaction by locally heating the substrate. Although the reactant systems used may be similar to conventional CVD, the film growth characteristics may differ in several ways. The changes in the optical properties of the film/substrate during deposition must be considered as the amount of laser energy absorbed determines the surface temperature and therefore the deposition rate. Also affecting the deposition rate is the diffusion of reactants to the reaction zone. Because of the small area heated in LCVD, higher surface temperatures can be accessed before diffusion and convection limit the deposition rate. For favorable reactant systems, very rapid deposition rates (greater than 100 μm/sec) and scan speeds for line deposition (greater than 10 cm/sec) can be achieved. 24 references, 5 figures, 2 tables.

23133 **Dynamic intersystem crossing in solid bis(phenanthroline)bis(cyanotrihydroborato)iron(II).** Edwards, M.P.; Hoff, C.D.; Curnutte, B.; Eck, J.S.; Purcell, K.F. (Kansas State Univ., Manhattan). *Inorganic Chemistry;* **23**: No. 17, 2613-2619(1984). Contract AC02-76ER02753.

From 185. national meeting of American Chemical Society; Seattle, WA, USA (1983).

Variable-temperature Moessbauer, magnetic susceptibility, and infrared studies of $Fe(phen)_2(NCBH_3)_2$ reveal the occurrence of a reversible, gradual singlet/quintet intersystem crossing above room temperature. Moessbauer spectra of the complex in the transition region are interpreted as showing the occurrence of a novel (for Fe(II)), fast singlet/quintet interconversion. 24 references, 5 figures, 3 tables.

23134 **High Si-H local mode overtones in $SiHD_3$.** Bernheim, R.A.; Lampe, F.W.; O'Keefe, J.F.; Qualey, J.R. III. (Pennsylvania State Univ., University Park). *Journal of Molecular Spectroscopy;* **104**: 194-198(1984).

Spectra for $SiHD_3$ obtained using a nonresonant photoacoustic cell mounted within the cavity of a CR490 tunable CW laser are reported herein. The symmetric top spectra exhibit partial rotational resolution. A relation for determining the Si-H bond distance is reported, and the Si-D bond distance is taken to be the same as the Si-H distance in the ground vibrational state. The bond angle is assumed to remain tetrahedral in both situations. The noted spectral vibrational band widths arise only from rotational structure with contributions from fast vibrational relaxation not being evident. 10 references, 2 figures, 1 table.

23135 **Neutron diffraction analysis of $[H_3Pt_2(Ph_2PCh_2CH_2PPh_2)_2]^+[BPh_4]$: an unusual example of an unsymmetrical $[P_2Pt(\mu\text{-}H)_2PtP_2H]$ core.** Chiang, M.Y.; Bau, R.; Minghetti, G.; Bandini, A.L.; Banditelli, G.; Koetzle, T.F. (Univ. of Southern California, Los Angeles). *Inorganic Chemistry;* **23**: No. 2, 122-124(1984).

An accurate single-crystal neutron diffraction analysis of the compound $[H_3Pt_2(Ph_2PCH_2CH_2PPh_2)_2]^+[BPh_4]\sqrt{}$ is reported

herein. The large crystal was obtained by the recrystallization of the compound from an acetone/ether mixture. The four coordinated platinum atom was found to have a normal square-planar geometry with interatomic angles close to ideal values. It was noted that the two bridging H atoms were marked by asymmetry of their position. The distances between the atoms are reported. The most accurate measurements of a terminal Pt-H bond distance to date is reported to be 1.610 A, while earlier measurements from x-ray diffraction were reported to be 1.527, 1.66, 1.78, and 1.98 A. 16 references, 1 figure.

23136 **Ghost vesicles.** Regen, S.L.; Shin, J.S.; Hainfeld, J.F.; Wall, J.S. (Marquette Univ., Milwaukee, Wisconsin). *Journal of the American Chemical Society;* **106**: 5756-5757(1984). Contract AC02-77ER04446.

The synthesis and preliminary characterization of the first example of ghost vesicle derived from polymerized vesicles of diallylammonium dihexadecylphosphate (1) plus sodium dihexadecylphosphate (2) are described herein. Vesicle polymerization was carried out by direct uv irradiation, and thin-layer chromatography indicated the disappearance of 1, retention of 2, and a product remaining at the origin. The resulting polymer was collected and analyzed, and the analysis agreed quite well with the theoretical values. The ir spectrum of the polymer showed nearly complete disappearance of the olefinic absorption band nu/sub c = c/ at 1635 cm^{-1} indicating that the extent of polymerization was high. 12 references, 2 figures.

23137 **Borane reduction of uracil derivatives.** Ghosh, C.; Schmidt, D.G.; Pal, B.C. (Oak Ridge National Lab., TN). *Journal of Organic Chemistry;* **49**: 5256-5257(1984).

The need for a method of synthesis of 4-hydroxy-5-(hydroxymethyl)-2-thiopyrimidine led to the borane reduction of several uracil derivatives. The method used to prepare hydroxy-methylpyrimidine was by reduction of the corresponding acid with uracil or uracil derivatives. The 5,6 double bonds of the uracil or uracil derivatives were found to be relatively reactive toward nucleophiles, and therefore, the choice reagents for selective reduction of the carboxyl group on acid precursors of the pyrimidines without affecting the 5,6 double bond is rather limited. Borane-tetrahydrofuran was found to be the reagent of choice for this reaction. 10 references, 1 table.

23138 **Intermolecular potentials for α-glycine from Raman and infrared scattering measurements.** Andrews, B.; Torrie, B.H.; Powell, B.M. (Univ. of Waterloo, Ontario). *Biophysical Journal;* **41**: 293-298(Mar 1983).

The frequencies of intermolecular modes in α-glycine-d_0 and -d_5 have been measured at 300 and 85 K by Raman and infrared scattering techniques. These frequencies were analyzed in terms of simple analytic interatomic potentials. Buckingham potentials were assumed for the nonbonded and hydrogen-bond interactions, and Coulomb and screened Coulomb potentials were assumed for the electrostatic interactions. The observed frequencies are well described by the simple model and the parameters of the hydrogen-bond potentials and the molecular charge distribution were determined from the analysis. 17 references, 4 figures, 5 tables.

23139 **Redox chemistry of metalloporphyrins in aqueous solution.** Harriman, A.; Richoux, M.C.; Neta, P. (Royal institution, London, England). *Journal of Physical Chemistry;* **87**: No. 24, 4957-4965(1983).

A series of water-soluble metalloporphyrins has been prepared and the redox chemistry investigated by electrochemical and pulse radiolytic techniques. All of the metalloporphyrins exhibit reasonably intense absorption transitions (upsilon = ca. 2 x 10^4 dm^3 mol^{-1} cm^{-1}) in the visible region and a strong absorption (upsilon = (2-7) x 10^5 dm^3 mol^{-1} cm^{-1}) around 430 nm. Cyclic voltammetry showed that the compounds undergo well-defined reduction and oxidation steps, although the oxidation processes were not really reversible. For diamagnetic metalloporphyrins, the difference in E/sub 1/2/ between addition and removal of an electron for a particular compound was 2.05 +/- 0.20 V while the difference in E/sub 1/2/ between addition of one and two electrons was 0.28 +/- 0.12 V. Similarly, E/sub 1/2/ for the removal of a second electron from the porphyrin π system was some 0.25 +/- 0.10 V higher than that for removal of the first electron. These findings are consistent with the central metal ion exerting only an inductive effect upon the porphyrin π levels. The absorption spectra of the one-electron reduction and oxidation products were recorded by pulse radiolysis methods. Both products exhibit broad absorption transitions stretching across the entire visible and near-IR regions. The reduction products were identified as π-radical anions and, in many cases, these were unstable with respect to disproportionation. The oxidation products were identified as π-radical cations and these were also unstable in aqueous solution but the decay route remains obscure. 44 references, 6 figures, 3 tables.

4004 Electrochemistry

23140 **(PB—87-139473/XAB) Experimental nickel-cobalt recovery from melt-refined superalloy scrap anodes. Report of investigations/1986.** Holman, J.L.; Neumeier, L.A. (Bureau of Mines, Rolla, MO (USA). Rolla Research Center). 1986. 24p. (BM-RI—9034). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600098.

The Bureau of Mines is conducting research to recover strategic and critical metals such as Ni, Co, and Cr from mixed contaminated superalloy scrap. One approach being studied involves melt refining of superalloy scrap to produce anodes for electrolytic deposition of Ni-Co alloy. This melt refining of superalloy turnings is described, based on melt-oxidation and oxidation-carburization experiments that use roasted superalloy grinding sludge to supply the O needed to oxidize Cr and other readily oxidized elements to the slag. Controlled melt-carburization subsequent to oxidation improved the metal-phase recovery of Ni and Co to sell over 90% and decreased electrolytic solubility of Cr, Mo, and W by carbide formation. Research is continuing to improve deposit quality in sustained deposition and to recover Cr and other metals from refining slags and anode sludges.

23141 **Improved response of carbon-paste electrodes for electrochemical detection in flow systems by pretreatment with surfactants.** Albahadily, F.N.; Mottola, H.A. (Oklahoma State Univ., Stillwater). *Analytical Chemistry;* **59**: No. 7, 958-962(1 Apr 1987). Contract FG05-85ER13346.

The uncompensated cell resistance of six carbon paste compositions used in carbon paste electrodes was measured before and after treatment with a 0.10% (w/v) aqueous surfactant solution. The surfactant treatment considerably lowered the paste uncompensated resistance by removing (or decreasing) the oily, insulating layer produced during the process of smoothing the electrode surface. Electrochemical evaluation of the untreated and treated surfaces was accomplished, by cyclic voltametry, square wave voltametry, and chronocoulometry. The improved response (increase is current) is, with some species, partially due to adsorption, but a significant increase in current was observed with species exhibiting no adsorption behavior (e.g., the reduced form of nicotinamide adenine dinucleotide, NADH). The improved response greatly enhances sensitivity in continuous-flow detection and the partial adsorption is not detrimental to response and quantitation under flow conditions.

23142 **Radiolytic and electrochemical reduction of $Ru(bpz)_3$2i in aqueous solution. Stability, redox, and acid-base properties of $Ru(bpz)_3^{+1}$.** Venturi, M.; Mulazzani, Q.G.; Ciano, M.; Hoffman, M.Z. (Universita di Bologna, Italy). *Inorganic Chemistry;* **25**: No. 25, 4493-4498(3 Dec 1986).

The reduction of $Ru(bpz)_3^{2+}$ in aqueous solution has been investigated by using radiolytic and electrochemical techniques. The one-electron reduction of $Ru(bpz)_3^{2+}$ by e/sub aq/$^-$, CO_2^-, and $(CH_3)_2COH$ radicals is rapid (k = (5-9) x 10^{10}, and 3.5 x 10^9 M^{-1} s^{-1}, respectively) and quantitative; the products of these reactions are $Ru(bpz)_3^+$, which can be represented as $Ru(bpz)_2(bpz^-)^+$, in alkaline solution and its conjugate acid $Ru(bpz)_2(bpzH)^{2+}$ (pK/sub a/ = 7.1 +/- 0.3) in acidic solution. In the absence of oxygen, $Ru(bpz)_3^+$ is stable; in the presence of MV^{2+}, an equilibrium is established with k($Ru(bpz)_3^+$ + MV^{2+}) = 1.3 x 10^8 M^{-1} s^{-1}, k($Ru(bpz)_3^{2+}$ + MV^+) 1.7 x 10^7 M^{-1} s^{-1}, and K/sub eq/ = 7.6. From these data and from cyclic voltammetric measurements a value of E^0($Ru(bpz)_3$/sup 2+/+/) = 0.50 V has been derived for alkaline aqueous solution. When the pH of the solution is changed

from alkaline to acidic, E/sub pc/ shifts toward less negative potentials by about 170 mV. Accordingly, $Ru(bpz)_2(bpzH)^{2+}$ is unable to reduce MV^{2+}; it is unstable (t/sub 1/2/ ~ 20 s), presumably toward a disproportionation reaction leading to the starting material and to the doubly reduced species $Ru(bpz)_2(bpzH_2)^{2+}$. The latter is also generated by controlled-potential electrolysis of $Ru(bpz)_3^{2+}$ in acidic solution; it can be electrochemically oxidized back to $Ru(bpz)_3^{3+}$, or it can generate $Ru(bpz)_2(bpz^-)^+$ slowly (t/sub 1/1/ ~ 1 h) upon reaction with OH^- under oxygen-free conditions.

4005 Photochemistry

REFER ALSO TO CITATION(S) 23124, 23794

23143 **(CONF-870377—2) Evaluation of ultraviolet light/ oxidizing agent as a means for the degradation of toxic organic chemicals in aqueous solutions.** Ho, P.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004261.

From International congress on recent advances in the management of hazardous and toxic wastes in the process industries; Vienna, Austria (8 Mar 1987).

Experiments have been performed to demonstrate the synergistic effect of ultraviolet light on the decomposition of toxic organic polynitro and polyhydroxy benzenes in aqueous solutions by hydrogen peroxide. These substances, which are hazardous to biota, can be degraded through photooxidation to carbon dioxide and water (and a small amount of nitric acid in the case of polynitrobenzenes). The degradation of these aromatic compounds is induced by the presence of hydroxyl radicals which are produced by the irradiation of hydrogen peroxide with ultraviolet light in water. Compounds such as 2,4-dinitrotoluene and phenol are first hydroxylated to di- and tri-hydroxybenzenes, followed by benzene-ring cleavage to produce lower-molecular-weight carboxylic acids and aldehydes via photooxidation. On further photooxidation, these carboxylic acids and aldehydes will eventually be converted to harmless carbon dioxide and water.

23144 **(DOE/ER/13111—3) Fundamental studies in charge separation at interfaces in relation to water photolysis: Progress report, January 1, 1985-July 31, 1986.** Hurst, J.K. (Oregon Graduate Center, Beaverton (USA). Dept. of Chemical and Biological Sciences). 23 Jul 1986. Contract AC06-83ER13111. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87005552.

Research on the dynamic behavior of vesicles containing bound redox ions is described. Emphasis has been placed upon understanding the role of interfacial electrostatics in controlling charge separation, use of kinetic mapping techniques to characterize binding sites, and distinguishing between diffusional and electron tunneling mechanisms in transmembrane oxidation-reduction. The most extensively studied experimental system comprised monoalkylviologens bound to anionic dihexadecylphosphate (DHP) vesicles or zwitterionic phosphatidylcholine (PC) liposomes. Major findings are that transmembrane redox appears to occur only for redox ions intercalated within the bilayer structure and that photostimulated diffusion, a phenomenon previously demonstrated for DHP vesicles, also occurs in PC liposomes. Research has also been initiated on a new series of dimeric ruthenium μ-oxo ions which show exceptional activity as homogeneous catalysts for water oxidation. Active and inactive compounds with very similar physical properties have been separated, offering the promise that structural characterization will yield fundamental insights into the molecular basis for catalytic activity.

23145 **Multiphoton ionization of nitric oxide-rare gas van der Waals species.** Miller, J.C. (Oak Ridge National Lab., Chemical Physics Section, Oak Ridge, TN). pp 76 of Digest of technical papers from the OSA/IEEE 1985 conference on lasers and electro-optics. Washington, DC; Optical Society of America (1985). (CONF-850558—).

From Conference on lasers and electro-optics; Baltimore, MD, USA (21 May 1985).

To date, most spectroscopic studies of electronic states of clusters involving small molecules and rare gas (RG) atoms have employed laser-induced fluorescence techniques. Consequently, such studies (e.g., Levy and co-workers on I/sub 2/-RG species) have been limited to the lower-lying electronic states, which are usually valence in character. Furthermore, identification of the cluster often must be inferred from spectral shifts, pressure dependence, etc. The authors have applied the technique of multiphoton ionization (MPI) to the study of the electronic spectroscopy of NO-RG van der Waals species and extended previous experiments. These works show several advantages of the MPI technique relative to the LIF method. Specifically, mass analysis can provide identification of the new species formed as well as allowing discrimination against other species (the parent monomer or higher clusters) while recording spectra. Furthermore, use of MPI photoelectron spectroscopy can provide data on the states of the cluster ion as well. The MPI technique has another advantage which is particularly important in the study of van der Waals molecules. This is the ability to study Rydberg states much more easily than LIF or other techniques.

23146 **Effects of molecular organization on photophysical behavior. Excimer kinetics and diffusion of 1-pyrenedecanoic acid in lipid monolayers at the nitrogen-water interface.** Subramanian, R.; Patterson, L.K. (Univ. of Notre Dame, IN). *Journal of the American Chemical Society;* **107**: 5820-5821(1985).

The time resolved behavior of pyrenedecanoic acid excimers in spread phospholipid monolayers at the air-water interface is reported herein. Interactions of the pyrene-bearing probe, 1-pyrenedecanoic (PDecA) have been compared as functions of probe concentration and hydrocarbon structure of the host liquid to the character of the lipid environment. The time resolved fluorescence measurements of mixed PDecA-lipid monolayers exhibit two features at 480 nm: a very fast rise in excimer intensity and a dependence of the excimer decay on PDecA mole fraction in the layer. 9 references, 3 figures.

23147 **Reaction of the psoralens with deoxyribonucleic acid.** Hearst, J.E.; Isaacs, S.T.; Kanne, D.; Rapoport, H.; Straub, K. (Univ. of California, Berkeley). *Quarterly Reviews of Biophysics;* **17**: No. 1, 1-44(1984). Contract W-7405-ENG-48.

This review has been limited to DNA reactions, and methods for radiolabelling psoralens, which have played an essential role in the isolation and purification of the photoproducts of the reaction between psoralens and nucleic acids, are reviewed herein. High-performance liquid chromatography procedures used for the separation of the photoadducts either as the nucleic adducts or as the free base adducts are discussed. Conclusions drawn from high-resolution proton magnetic resonance and high-resolution mass spectrometric studies of the structural determination of the isolated and purified adducts presented here have led to the assignment of the stereochemistry of the products and leave no doubt that the DNA helix influences both the kinetics and the stereospecificity of the photochemical reaction. The optical properties of the reactants and the photoproducts are catalogued. The kinetics of the photochemistry and its relationship to the fundamental properties of the various psoralen derivatives are discussed. 41 references, 19 figures, 8 tables.

23148 **Triplet-mediate photoreduction of viologens by aromatic hydrocarbons: a laser flash-photolysis study.** Das, P.K. (Univ. of Notre Dame, IN). *Journal of the Chemical Society, Faraday Transactions 1;* **79**: 1135-1145(1983).

Using laser flash photolysis the electron-transfer (e.t.) reactions involving a number of aromatic hydrocarbon triplets (donors) and several bipyridinium and pyridinium salts (acceptors) have been examined in terms of redox quenching rate constants (k/sub e.t./), e.t.-derived photoproduct yields (eta) and rate constants (k/sub b/) for back e.t. reactions among the photoproducts. The observed values of k/sub e.t./, eta and k/sub b/ with paraquat as the quencher in a 1:9 water + acetonitrile mixture are typically in the ranges (5-10) x 10^9 dm^3 mol^{-1} s^{-1}, 0.7-1.0 and (2-4) x 10^9 dm^3 $mol^{-1}s^{-1}$, respectively. In both methanol and 1:9 water + acetonitrile the transient absorption spectra of primary photoproducts show the formation of radical cations of aromatic hydrocarbons in addition

to the one-electron-reduction products of viologens. For free-energy changes (ΔG) of triplet-mediated electron transfer ranging from 17 to -96 kJ mol^{-1}, plots of log (k/sub e.t.) against redox potentials of viologen acceptors or triplet hydrocarbon donors are found to bend at small absolute value of ΔG values with slopes estimated at 8-10 V^{-1} in the bending regions; there is no indication of the bending of the plots at very large, negative ΔG values (up to -96 kM mol^{-1}). 26 references, 5 figures, 3 tables.

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REFER ALSO TO CITATION(S) 23142

23149 (IA—1421, pp 120) **Kinetics of formation and decomposition of the methyl-copper(II) complex in aqueous solutions. A pulse radiolysis study.** Cohen, H.; Meyerstein, D. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.
Published in summary form only.
In Research laboratories annual report 1985.

23150 (IA—1421, pp 127-128) **Grafting of acrylamide to nylon-6 by the electron beam preirradiation technique. V. Permeability and selectivity of the grafted membranes.** Haruvy, Y.; Rajbenbach, L.A.; Jagur-Grodzinski, J. (Israel Atomic Energy Commission, Tel Aviv; Weizmann Inst. of Science, Rehovoth, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.
Published in summary form only.
In Research laboratories annual report 1985.

23151 (IA—1421, pp 128-129) **Mechanistic features of gamma radiation-induced formation of Pt hydrosols.** Haruvy, Y.; Rajbenbach, L.A. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.
Published in summary form only.
In Research laboratories annual report 1985.

23152 (IA—1421, pp 129-130) **Synthesis of fluorinated ionomer membranes by the electron beam preirradiation method.** Mey-Marom, A.; Shkolnik, S. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.
Published in summary form only.
In Research laboratories annual report 1985.

23153 (IA—1421, pp 119) **Kinetics of β-hydroxyl elimination from [(protoporphyrin)Fe(III)-CHRCH/sub 2/OH] in aqueous solutions. A pulse radiolytic study.** Sorek, Y.; Cohen, H.; Meyerstein, D. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.
Published in summary form only.
In Research laboratories annual report 1985.

23154 (INIS-mf—10574) **Scientific conference proceedings. Session 4. Ionizing radiation.** Bartosek, V. (ed.). (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1985. 84p. (In Czech). (CONF-8506335—Pt.4). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448.
From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).
Session 4 of the conference was held on 7 June 1985 at Rez near Prague. 17 papers were submitted dealing with radiation chemistry and radiation technologies, dosimetry, technology of producing labelled compounds and their uses in medicine, determination of elements by neutron activation analysis and infrared, mass and atomic absorption spectroscopy. All contributions were inputted to INIS. (M.D.).

23155 (INIS-mf—10574, pp 5-8) **Radiolysis of spray solutions.** Habersbergerova, A.; Janovsky, I. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).
From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).
The factors were studied affecting thiosulfate radiolysis in the so-called spray solution for nuclear power plant containments. The reaction mechanism of primary radiolytic reactions leading to thiosulfate decomposition was studied using pulse radiolysis. Also measured was hydrazine loss in the irradiation of the bubbling solution intended for the capture of volatile chemical forms of radioiodine. Pulse radiolysis was used to study the kinetics of hydrazine reaction with elemental iodine.

23156 (INIS-mf—10574, pp 9-11) **Role of radiation chemistry in development of nuclear power and radiation technologies.** Bartonicek, B. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).
From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).
Prospective trends are briefly outlined of radiation technology applications in elastomer curing and cross linking of plastics, sterilization of materials and supplies for human and veterinary medicine, polymerization, copolymerization and grafting, the treatment of foods and agricultural produce, and the treatment of industrial and waste waters and gases. Main tasks are indicated of radiation chemistry concerning the operation of nuclear power plants, such as oxygen disposal, the processing of organic radioiodine forms, of radioactive wastes, etc. (B.S.).

23157 (INIS-mf—10574, pp 19-21) **Radiation formation of methyl iodide.** Bartonicek, B.; Habersbergerova, A.; Pejsa, R. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).
From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).
The results are summed up of a study of methyl iodide formation in radiolysis and pyrolysis of mixtures of methane, iodine, air and water vapour, and in the irradiation of two-phase system where the liquid phase consisted of an aqueous solution of potassium iodide while the gaseous phase consisted of methane, water vapour and air or argon.

23158 (INIS-mf—10574, pp 23-24) **Radiation cross-linked polyethylene-based insulating mix.** Vokal, A.; Cernoch, P.; Kourim, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).
From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).
The effect was studied of different admixtures, such as antioxidants, flame retarders, sensibilizers and pigments, on the efficiency of radiation cross-linking and the properties of cross-linked polyethylene with respect to the development of an insulation mix for interconnect leads.

23159 (PPA-T—47) **Electron beam-induced graft copolymerization of vinyl monomers on to polyester fibre.** Hussin Mohamad Nor. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Apr 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701598.
Electron beam-induced graft copolymerization of acrylic acid on to multifilament PET fibre was carried out by simultaneous method. The fibre was impregnated with acrylic acid at room tem-

perature and the impregnated fibre was irradiated with electron beams in air. The effects of impregnation time, swelling agent, monomer composition, dose, dose rate and grafting temperature have been investigated. Four hour impregnation time was found to be sufficient to obtain the maximum weight percentage of grafting for this system. Among the swelling agents employed, formic acid was found to be the most effective. Some properties of several percentage of grafting have been studied by means of Optical Microscope, X-rays Microanalyzer and Differential Scanning Calorimeter. Optical microscopic observations show that the diameter of graft fibres increases with the increasing percentage of grafting. X-rays microscope analysis shows that the distribution of grafts across the PET cross-sections is more intense at the surface in comparison to the core of the fibres. It is learned from DSC measurements that the melting point of graft fibres decreases slightly as the weight percentage of grafting increases.

23160 **Dependence of the predicted outdoor lifetime of bisphenol-A polycarbonates on the terrestrial UV irradiance spectrum.** Webb, J.D.; Czanderna, A.W. (Solar Energy Research Institute, Golden, CO, USA). *Solar Energy Materials;* **15**: No. 1, 1-8(Jan 1987).

The outdoor lifetimes for sheets of bisphenol-A polycarbonate (BPA-PC) having different concentrations of phenolic terminal groups were predicted as a function of the average terrestrial UV irradiance spectrum measured at several latitudes. The lifetimes were based upon chain scission rates predicted to occur in a thin surface layer of unstabilized BPA-PC sheet, and were less than the outdoor lifetime reported for sheets of stabilized material. These rates were derived from chain scission quantum yields measured at 287 and 308 nm in thin solid films of BPA-PC. In general, these rates will be extremely dependent on latitudinal, seasonal, and possibly diurnal variations in the wavelength distribution of terrestrial UV irradiance, and on the concentration of phenolic end groups. Reducing the concentration of phenolic terminal groups by a factor of two in commercial BPA-PC by acetylation (capping) lowers the chain scission quantum yield, reduces terrestrial UV absorbance, and nearly doubles the predicted outdoor lifetime of the material at North latitudes of 9 deg., 39 deg., and 71 deg. High concentrations of terminal phenolic groups in BPA-PC induce a cross-linking reaction which competes with chain scission at 308 nm and predominates at 287 nm. 17 refs.

23161 **Conformational equilibria in trans-1,2-diarylethylenes manifested in their emission in solution. Part VI. Heterocyclic analogues, their triplets and exciplexes.** Wismontski-Knittel, T.; Das, P.K.; Fischer, E. (Weizmann Institute of Science, Rehovot, Israel). *Helvetica Chimica Acta;* **67**: 2246-2253(1984).

Solutions of heterocyclic analogues of 2-styrylnaphthalene (2-St-N), with benzo[b]thiophene and benzo[b]furan groups replacing the 2-naphthyl group, exhibit emission anomalies similar to those reported for 2-St-N, the most prominent one being a variation of the emission spectra with the excitation wavelength. The exciplexes formed when emission is quenched by N,N-dimethylaniline (DMA) show a smaller variation of their emission maxima. Ground-state rotamers may be responsible for the anomalies. The lifetimes of regular fluorescence in toluene are ≦ 2 ns, and their equipment did not allow to determine whether or not the decay is mono-exponential. Exciplex lifetimes in toluene are 20-30 ns. The triplets (δ/sub max//sup T/ = 500-520 nm) are characterized by short lifetimes (180-190 ns) and appear to have substantial contributions from twisted configurations. 14 references, 5 figures, 4 tables.

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REFER ALSO TO CITATION(S) 22239, 23589, 23590, 23619

23162 **(CRN-CPR—86-04) Isotopic exchange in mixed valence compounds in the solid state.** Fernandez Valverde, S.M. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1986. 200p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE87751145.

This work aims at the determination of isotopic exchange kinetics and mechanism in two mixed valence compounds: $Cs_{10}(Sbsup(V)Cl_8)$ $(Sbsup(III)Cl_6)_3$ and $Tl_3sup(I)(Tlsup(III)Cl_6)$. The synthesis of the first compound is very difficult because in most of the cases mixtures of chloroantimoniates are obtained. Exchange in Tl_4Cl_6 labelled on Tlsup(III) is studied in detail by radiochemical analysis and physical techniques: ionic conductivity and positon annihilation. Cation vacancies are easily created in the lattice with formation enthalpy of 0.35 eV and migration enthalpy of 0.52 eV. Isochronic and isothermal exchange curves are described by a kinetic based on species diffusion. Models are given. Exchange is increased by grinding probably because extrinseque defects are introduced..

23163 (IA—1421, pp 143) **Synthesis of tritiated indolyl butyric acid labelled in position 5.** Shimoni, M.; Buchman, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23164 (IA—1421, pp 143-144) **Tritium synthesis of an adrenal cortex derivative. 21-Deoxycortisol-1,2-/sup 3/H.** Buchman, O.; Shimoni, M.; Cohen, A. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23165 (IA—1421, pp 144-145) **Rapid and mild radioiodination of sensitive proteins.** Canfi, I.; Freud, A.; Zafran, M.; Teitelbaum, Z.; Weill, S.; Nevo, Z. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel; Sheba Medical Center, Tel Hashomer, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23166 (IA—1421, pp 145) **Radioiodination of serum amyloid protein.** Freud, A.; Canfi, A.; Teitelbaum, Z.; Caspi, D. (Israel Atomic Energy Commission, Tel Aviv; Ichilov Hospital, Tel Aviv, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23167 (IA—1421, pp 145-146) **Attempts to synthesize tritium labelled 4-benzoylbenzoic acid.** Shimoni, M.; Azran, J.; Cohen, A.; Buchman, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23168 (IA—1421, pp 146-147) **Structure-reactivity in the bromination of some tricyclic compounds.** Azran, J.; Shimoni, M.; Pri-Bar, I.; Cohen, A.; Hagag, Y.; Buchman, O. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23169 (IAEA-RL—127, pp 59-76) **Preparation of additional supplies of /sup 244/Pu.** Bigelow, J.E.; Newman, E.; Alexander, C.W. (USDOE New Brunswick Lab., NJ; UKAEA Atomic Energy Research Establishment, Harwell). Oct 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE87701514. (CONF-8510272—Summ.).

From IAEA consultants' meeting on nuclear reference materials needs and availability; Antwerp, Belgium (8 Oct 1985).

In the mid-1970s, gram quantities of the man-made isotope /sup 244/Pu were produced in high purity for basic research as a by-product of a program to prepare gram quantities of /sup 252/Cf. Because /sup 244/Pu is not produced in appreciable quantities in standard power reactor fuel, this nuclide has become extremely useful in the application of isotope dilution mass spectrometry (IDMS), a high-precision analytical technique, to problems of plutonium accountability in support of international safeguards agree-

ments. Although only a small amount (a fraction of a microgram) is needed for each analysis, the present supply of certified nuclear reference standard SRM-996 is expected to last only an additional 3 to 5 years. Three options for producing additional supplies of this rare and valuable material were examined. The options encompassed the production of from 1 to 8.5 g during time spans of from 3 to 10 years. Unit costs ranged from $2300 to $7200 per mg of plutonium of >97% /sup 244/Pu. While the paper concludes that the short-term option can be pursued along with further study of the longer-term options, this should not be regarded as an offer or a commitment on the part of the U.S. Department of Energy (USDOE) to furnish the described material. 11 tabs.

23170 (INIS-mf—10548, pp 113-120) **Enzymatic synthesis of multiple-tritium-labelled nucleonic acid components from nitrous bases.** Myasoedov, N.F.; Kuznetsova, O.B.; Lazurkina, T.Yu.; Frank-Kamenetskaya, M.D. (AN SSSR, Moscow. Inst. Molekulyarnoj Genetiki). 1982. (In Russian). NTIS (US Sales Only), PC A14/MF A01. File Number DE87780080. (CONF-8112124—Pt.2).

From 2. Council for Mutual Economic Assistance (CMEA) member-countries symposium; Leningrad, USSR (8 Dec 1981).

A single-step enzymatic synthesis of multiple-tritium-labelled nucleoside mono-, di- and triphosphates from bases involving an enzyme preparation from E.cold cells is described. The kinetics of phosphoribosylation and phosphorylation have been investigated. The procedure is described for isolating all the obtained compounds by ion-exchange chromatography. Data are presented concerning the effects of molar radioactivity on the kinetic curves describing the transformation of multiple-tritium-labelled bases into nucleotides. 5 figs.; 8 refs.

23171 (INIS-mf—10574, pp 29-32) **Production technology of sodium /sup 125/I-iodide.** Kronrad, L.; Hradilek, P.; Kopicka, K. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

A new method was developed and tested in pilot plant operation, of the production of sodium /sup 125/I-iodide from XeF/sub 2/ irradiated with neutrons in a nuclear reactor. /sup 125/I was separated from the irradiated target by sublimation at a temperature of 923 K and subsequently of 1078 K. Its absorption in 1 to 5 ml of a 10/sup -2/ M NaOH solution results in its transformation to sodium /sup 125/I-iodide. A minimum activity of 3.7 GBq/ml, minimum radiochemical purity of 99% in form of I/sup -/and minimum radionuclide purity of 99% /sup 125/I were obtained. For routine production, a laboratory provided with a shielded box and the necessary single-purpose instruments was put into operation. (B.S.).

23172 (INIS-mf—10574, pp 33-36) **/sup 201/Tl-thallium chloride injections for cardiological applications.** Kopecky, P.; Zdrazil, K.; Svihla, P. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

The production is being prepared by the Nuclear Research Institute at Rez of the cardiovascular diagnostic agent, /sup 201/Tl-thallium chloride. The /sup 201/Tl radionuclide will be produced by irradiating a thallium target in the U-120 M cyclotron at Rez. For this purpose, the /sup 201/Tl production rate was measured in the proton energy range of 27 to 31 MeV, and the production conditions were optimized with respect to parasitic production of radionuclide contaminants /sup 200/Tl and /sup 202/Tl. A method was developed of chemically separating /sup 201/Tl from the irradiated target. This will allow the production of /sup 201/Tl-thallium chloride injections in the required quality.

23173 (INIS-mf—10574, pp 37-40) **Liver diagnosis using bromosulfophthalein labelled with iodine radionuclides.** Kopicka, K.; Hradilek, P.; Kronrad, L. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701448. (CONF-8506335—Pt.4).

From Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute; Rez, Czechoslovakia (6 Jun 1985).

The methods are reported of labelling and analytical testing of /sup 131/I-bromosulfophthalein prepared for production to meet the needs of Czechoslovak nuclear medicine. Analytical methods used up to date are critically reviewed. In view of the fact that /sup 131/I-bromosulfophthalein can contain both the labelled monoiodine derivative and the diiodine derivative, the feasibility was tested of their analytical separation. A method of selective labelling of both derivatives was developed.

23174 (INIS-mf—10578, pp P79) **Preparation of [/sup 3/H]-phe sup (B1) insulin.** Grant, K.I.; Van Holt, C. (Cape Town Univ., South Africa. Dept. of Biochemistry). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23175 (INIS-mf—10578, pp P166) **Preparation of C-labelled aflatoxins with high specific activity and yield.** Williams, K.R.; Dutton, M.F. (Natal Univ., Pietermaritzburg, South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23176 (INIS-mf—10578, pp P267) **Biotinylated insulin: preparation and assay.** Smith, P.; Hapgood, J.; Grant, K.; Von Holt, C. (Cape Town Univ., South Africa. Dept. of Biochemistry). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23177 **(YJT—86-28) Dissolution of unirradiated uranium oxide pellets at various parametric conditions.** Ollila, K. (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Sep 1986. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750680.

The solubility of unirradiated UO/sub 2/ fuel pellets in synthetic groundwater has been investigated. A sequential dissolution procedure was used, and the extent of dissolution was measured by activation analysis for uranium in groundwater. Plated-out and/or precipitated material were included in the analysis. Dissolution was performed under different pH and redox conditions in two synthetic groundwaters, one simulating the undisturbed chemical conditions deep in granitic bedrock and the other simulating the effects of bentonite. The measured uranium concentrations in oxidizing conditions in the undisturbed synthetic groundwater and bentonite water varied 1 - 4 and 1 - 2 mg U/l, respectively. The concentration of uranium under reducing conditions decreased rapidly already during the shorter dissolution periods being 1 - 25 μg U/l in the undisturbed synthetic groundwater and 10 - 190 μg U/l in bentonite water. The dissolution as a function of pH gave the lowest solubilities for uranium at the neutral or slightly alkaline pH region 8 - 10 expected for deep groundwater.

23178 **Continous separation and identification of neutron-rich neptunium isotopes from heavy-ion reactions by means of the centrifuge system SISAK.** Tetzlaff, H.; Herrmann, G.; Kaffrell, N.; Kratz, J.V.; Rogowski, J.; Trautmann, N.; Skalberg, M.; Skarnemark, G.; Alstad, J.; Fowler, M.M. (Mainz Univ., Germany, F.R.; Chalmers Univ. of Technology, Goeteborg, Sweden; Oslo Univ., Norway; Los Alamos National Lab., NM). *Journal of the Less-Common Metals;* **122**: 122(Aug 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

Neutron-rich neptunium isotopes formed in direct transfer reactions between ^{136}Xe projectiles and targets of ^{244}Pu have been separated from other reaction products with the on-line liquid-liquid extraction system SISAK. A four-detector delay method was used to determine the half-lives of the previously unknown isotopes ^{243}Np and ^{244}Np. From the decay of the 287.4 keV γ-line a half-life of 1.8+-0.3 min was determined for ^{243}Np. From the decay curves of the γ-lines at 162.7 and 216.7 keV, which fit into the known level scheme of ^{244}Pu, a half-life of 2.5+-0.3 min results for ^{244}Np.

23179 **Thermochemical studies on the plutonium fluorides and protactinium oxides.** Kleinschmidt, P.D.; Ward, J.W. (Los Alamos National Lab., NM). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

The ionization and appearance potentials of parent and fragment ions from the neutral molecules PuF_6 and PuF_5 were measured using electron impact ionization. From this data the bond dissociation energies of the molecules PuF/sub n/-F (n=0 to 5) were calculated. Vapor pressures of PaO_2(g), PaO(g) and Pa(g) were measured above the two-phase system Pa(l)+PaO/sub 2-4/(s), and the congruently vaporizing composition PaO/sub 2-x/(s). From these measurements, the enthalpies of formation of Pa(g), PaO(g) and PaO_2(g) were calculated to be respectively 131.7+-6.1 (551+-26), 2.4+-4.1 (10+-17), and -122.7+-4.0 (-513+-17) kcal mol^{-1} (kJ mol^{-1}). Bond dissociation energies of PaO-O and Pa-O were found to be respectively 184.6+-4.1 (772+-17) and 188.4+-4.1 (788+-17) kcal mol^{-1} (kJ mol^{-1}).

23180 **Chemistry of berkelium: a review.** Hobart, D.E.; Peterson, J.R. (Los Alamos National Lab., NM; Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

23181 **Low temperature preparation of actinide hexafluorides by O_2F_2 and KrF_2.** Asprey, L.B.; Eller, P.G.; Kinkead, S.A. (Los Alamos National Lab., NM). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

23182 **Reaction of PuH/sub x/ and Pu+PuH/sub x/ mixtures with air.** Haschke, J.M.; Hodges, A.E. III. (Rockwell International Corp., Golden, CO). *Journal of the Less-Common Metals;* **121**: 121(Jul 1986). (CONF-8509147—).

From ACTINIDES '85; Aix-en-Provence, France (1 Sep 1985).

23183 **Nucleophilic aromatic substitution of activated cationic groups by ^{18}F-labeled fluoride. A useful route to no-carrier-added (NCA) ^{18}F-labeled aryl fluorides.** Angelini, G.; Speranza, M.; Wolf, A.P.; Shiue, C.Y. (Brookhaven National Lab., Upton, NY). *Journal of Fluorine Chemistry;* **27**: 177-191(1985).

A method is described for the rapid preparation of no-carrier-added (NCA) ^{18}F-labeled aryl fluorides by treatment of the corresponding aryltrimethylammonium perchlorates with ^{18}F-labeled fluoride in DMSO. The basic features of the ^{18}F-for-$^{+}NM_3$ displacement process are evaluated as a function of the experimental variables and compared with related substitution routes to NCA ^{18}F-labeled aryl fluorides. The relative nucleofugicity of the ammonium group in the nucleophilic substitution reactions surpasses that of the best neutral leaving groups, including NO_2 and F itself. In contrast, radiofluoride incorporation into aromatic rings via other cationic substrates, such as aryldimethylsulfonium perchlorates, is prevented by the fast methyl group transfer from the starting compound to the nucleophiles present. The use of the ammonium function as a leaving group in nucleophilic substitutions by $^{18}F^{-}$ may give access to the rapid preparation of novel NCA ^{18}F-radiopharmaceuticals by facilitating the synthesis and the purification of their labeled precursors. 15 references, 1 figure, 6 tables.

23184 **Behavior of americium in aqueous carbonate systems.** Silva, R.J. (Lawrence Berkeley Lab., CA). *Materials Research Society Symposia Proceedings;* **26**: 875-881(1984). Contract AC03-76SF00098.

The solubilities of crystalline $Am(OH)_3$ and $AmOHCO_3$ were measured at 25° C in aqueous solutions of 0.1 M $NaClO_4$ by determination of the solution concentrations of Am. Prior to use in the measurements, the solid and materials were characterized by their x-ray powder diffraction patterns. The solubility product quotients were calculated from the experimental data. The hydrolysis quotients of Am^{3+} were also estimated from the hydroxide solubility data. Using the thermodynamic data derived from these experiments and the recently reported formation constants for the Am^{3+} carbonate complexes, the solid phases and concentrations of solution species of americium in several aqueous carbonate systems were calculated using the computer code MINEQL. 20 references, 1 figure, 1 table.

23185 **Actinide-specific complexing agents: their structural and solution chemistry.** Raymond, K.N.; Freeman, G.E.; Kappel, M.J. (Lawrence Berkeley Lab., CA). *Inorganica Chimica Acta;* **94**: 193-204(1984). Contract AC03-76SF00098.

The synthesis of a series of tetracatecholate ligands designed to be specific for Pu(IV) and other actinide-(IV) ions has been achieved. Although these compounds are very effective as in vivo plutonium removal agents, potentiometric and voltammetric data indicate that at neutral pH full complexation of the Pu(IV) ion by all four catecholate groups does not occur. This implies more acidic chelating groups must be incorporated in the next cycle of ligand design, synthesis and evaluation for chelating agents specific for Pu(IV). Spectroscopic results indicate that the tetracatecholates, 3,4,3-LICAMS and 3,4,3-LICAMC, complex Am(III). The Am(IV)/(III)-catecholate couple (where catecholate = 3,4,3-LICAMS or 3,4,3-LICAMC) is not observed, but may not be observable due to the large currents associated with ligand oxidation. However, within the potential range where ligand oxidation does not occur, these experiments indicate that the reduction potential of free Am(IV)/(III) is probably ≧ + 2.6 V vs. NHE or higher. Proof of the complexation of americium in the trivalent oxidation state by 3,4,3-LICAMS and 3,4,3-LICAMC eliminates the possibility of tetracatecholates stabilizing Am(IV) in vivo. 83 references, 19 figures.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 22189, 23733

23186 **(UCRL—94769) Hybrid closed bomb-strand burner for very high pressure burning rate measurements.** Costantino, M.; Ornellas, D. (Lawrence Livermore National Lab., CA (USA)). 8 Oct 1986. Contract W-7405-ENG-48. 11p. (CONF-8610210—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001357.

From 23. joint Army Navy NASA Air Force combustion meeting (JANNAF); Hampton, VA, USA (20 Oct 1986).

A hybrid closed bomb-strand burner is described that is suitable for burning rate measurements at pressures in excess of 1 GPa (150,000 PSI). The device is a cylindrical pressure vessel having an internal volume of about 50 cc and a means of extracting up to fifteen electrical or fiber optic signals. The sample is a right circular cylinder 6.35mm in diameter and 10 cm long with an epoxy coating on the outside surface as an inhibitor. The sample fits in a fixture which prevents its motion during the burn and provides mounting

points for the diagnostics that detect the arrival of the burning surface. A variety of break wires and ionization probes to trigger the timing electronics have been used. At the burning rates of present interest (less than 1 m/s), the pressure was measured using an external load cell. An experiment consists of a pre-pressurizing the vessel with argon, igniting the sample at one end, and measuring the pressure and the time of arrival at each probe. The average burning rate between wire locations n-1 and n, over the pressure range (P/sub n-1/,P/sub n/), is r/sub n-1,n/ = (x/sub n/-x/sub n-1/)/(t/sub n/-t/sub n-1/), giving a large portion of the burning rate-pressure curve in a single experiment.

23187 **Conditional sampling of velocity and scalars in turbulent flames using simultaneous LDV-Raman scattering.** Dibble, R.W.; Hartmann, V.; Schefer, R.W.; Kollmann, W. (Sandia National Labs., Livermore, CA, USA; California Univ., Davis, USA. Dept. of Mechanical Engineering). *Experiments in Fluids;* **5**: No. 2, 103-113(1987).

The Laser Doppler/Velocimeter (LDV) measures the velocity distribution of particles which is often an acceptable representation of the distribution of gas velocities. However, in turbulent two stream mixing flows, the particle velocity distribution will differ from the gas velocity distribution when the particle densities in the two streams are unequal. This bias is explored in a reacting and nonreacting turbulent jet which is surrounded by coflowing air. By adding seed particles to only the coflow air and then to only the jet fluid, the limits of this bias are established. Additional measurements with an LDV triggered laser Raman scattering system demonstrate that the bias in the LDV sampling is propagated to the Raman measurements. An analytical equation is presented which will generate unbiased velocity and scalar distributions from measurements obtained from seeding only one stream at a time.

23188 **Interaction of pulsating and spinning waves in condensed phase combustion.** Booty, M.R.; Margolis, S.B.; Matkowsky, B.J. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **46**: No. 5, 801-843(Oct 1986).

The authors employ a nonlinear stability analysis in the neighborhood of a multiple bifurcation point to describe the interaction of pulsating and spinning modes of condensed phase combustion. Such phenomena occur in the synthesis of refractory materials. In particular, they consider the propagation of combustion waves in a long thermally insulated cylindrical sample and show that steady, planar combustion is stable for a modified activation energy/melting parameter less than a critical value. Above this critical value primary bifurcation states, corresponding to time-periodic pulsating and spinning modes of combustion, emanate from the steadily propagating solution. By varying the sample radius, the authors split a multiple bifurcation point to obtain bifurcation diagrams which exhibit secondary, tertiary, and quarternary branching to various types of quasi-periodic combustion waves.

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23189 **(SAND—86-1589C) Techniques for implementing statically complete component mode synthesis for forced response.** Allen, J.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870446—1). NTIS, PC A02. File Number DE87002698.

From 5. international modal analysis conference; London, UK (6 Apr 1987).

The Component Mode Synthesis (CMS) method is a Raleigh-Ritz technique, which allows structural models to be reduced in size and coupled with other analytical or experimental components. The CMS transformation uses combinations of static and dynamic trial vectors. Static trial vectors (constraint modes) for all component interface degrees of freedom (DOF) and externally loaded DOF need to be included in the CMS transformation to produce a statically complete CMS transformation. This requirement for aerospace models with surface pressure loads would be restrictive. This study will investigate techniques for producing a statically complete solution using a CMS method, which has a statically incomplete set of constraint modes. The study will also investigate the additional problems involved with the multi-level CMS. The study will be conducted by modifying the transient and frequency response solution sequences of NASTRAN.

23190 **(UCID—20989) Nonlinear coupling processes of high-power microwaves into enclosures.** Yee J.H.; Sieger, G.S.; Mayhall, D.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006875.

Numerical calculations were used to determine the effects of air breakdown on the coupling of intense microwave pulses passing through apertures. Calculations are based on a set of Maxwell equations and electron-fluid equations. Results show that the air-breakdown threshold energies in apertures have a functional dependency on pressure similar to that of air-breakdown threshold energies in the atmosphere. Variations of the transmitted energies of intense microwave pulses passing through apertures as a function of incident-field intensity and aperture size are presented. The effects of secondary emission on the air-breakdown threshold energies around apertures are also discussed.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 22331, 22332, 22340, 22418, 22517, 22673, 22983, 23223, 23388

23191 **(BDX—613-3687) Decomposition of hazardous organic materials by RF-activated gas plasma: Topical report.** Smith, M.D. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Mar 1987. Contract AC04-76DP00613. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006886.

The RF-activated gas plasma decomposition of hazardous organic materials was demonstrated using two materials, dimethylformamide and polychlorinated biphenyls, in oxygen plasmas of relatively low power levels. Analysis by gas chromatography and mass spectrometry confirmed that the materials had been reduced to their smallest molecular components. Possible applications of the technology are outlined.

23192 **(CONF-861265—1) Manipulator technology: The critical element of useful autonomous "working" machines.** Hamel, W.R.; Babcock, S.M. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 13p. NTIS MF A01; GPO Dep. File Number DE87003657.

From Intelligent autonomous systems international conference; Amsterdam, Netherlands (8 Dec 1986).

The structure and characteristics of mobile autonomous robots which can perform useful work are discussed. The objective of the discussion is to assess the state of the technology particularly with regard to robot mechanization and the implementation of a "human-like" performance capability. Technology limitations in manipulators and locomotion are significant. If not task constrained, it appears that an anthropomorphic autonomous robot would likely be much larger physically and an order of magnitude heavier than a human equivalent. Research in high-performance, lightweight manipulators, servoactuators, and power supply systems is needed.

23193 **(CONF-870301—9) Traction drive seven degrees-of-freedom telerobot arm: A concept for manipulation in space.** Martin, H.L.; Kuban, D.P. (TeleRobotics International, Inc., Knoxville, TN (USA); Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004066.

From International topical meeting on remote systems and robotics in hostile environments; Pasco, WA, USA (29 Mar 1987).

This new concept for manipulation in space is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges the best characteristics of teleoperation and robotic technologies. The design goals for the telerobot, a mechanical and control description, and technology areas that must be addressed for successful implementation will be presented and discussed. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator

capable of obstacle avoidance. Further development of this arm is in progress at Oak Ridge National Laboratory.

23194 **(CONF-870395—1) Telerobotic technology for nuclear and space applications.** Herndon, J.N.; Hamel, W.R. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007012.

From American Institute of Astronautics and Aeronautics, National Aeronautics and Space Administration and U.S. Air Force (AIAA/NASA/USAF) symposium on automation, robotics and advanced computing for the N; Arlington, VA, USA (9 Mar 1987).

Telerobotic development efforts at Oak Ridge National Laboratory are extensive and relatively diverse. Current efforts include development of a prototype space telerobot system for the NASA Langley Research Center and development and large-scale demonstration of nuclear fuel cycle teleoperators in the Consolidated Fuel Reprocessing Program. This paper presents an overview of the efforts in these major programs. 10 refs., 8 figs.

23195 **(EPRI-EL—4912) Metallurgical development and manufacture of large heavy structures for cryogenic applications: Final report.** Hooper, G.W.; Friedman, L.M.; Male, A.T. (Westinghouse Electric Corp., Orlando, FL (USA). Steam Turbine Generator Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 724p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920286.

Producing the intricate structures of the superconducting generator rotor requires special manufacturing and metallurgical processing techniques. Inconel alloy 706, selected in this project as the best material for rotor components, retains its superior strength at cryogenic temperatures.

23196 **(GA-A—18751) Validation of elastic-plastic computer analyses for use in nuclear waste shipping cask design.** Koploy, M.; Schlafer, W.; Zimmer, A. (GA Technologies, Inc., San Diego, CA (USA)). Feb 1987. Contract AC04-80SF10791. 8p. (CONF-870306—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007048.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

GA Technologies designed the Defense High Level Waste (DHLW) Truck Shipping Cask using state-of-the-art analytical techniques verified by model testing performed by Sandia National Laboratories (SNL). The DHLW cask has a thick-walled stainless steel body and incorporates integral stainless steel impact limiters that protect the two ends of the cask during the hypothetical accident condition 30-ft free drop. These integral impact limiters absorb the drop energy through gross plastic deformations. GA used elastic-plastic computer codes developed at Los Alamos and Lawrence Livermore Laboratories, HONDOII and DYNA3D, to analyze for this non-linear behavior. In order to evaluate the analyses, GA developed elastic-plastic stress criteria that were adapted from the ASME Boiler and Pressure Vessel Code, Division I, Section III. This innovative design and analytical approach required test verification. Therefore, SNL performed 30-ft drop and puncture tests on a half-scale model of the DHLW cask. The testing conformed that the analytical approach works and results in a safe, conservative design.

23197 (INIS-mf—10589, pp 81-82) **Determination of removal efficiency of vent-air system filters of V-1 nuclear power plant.** Kubik, I.; Pietrik, I.; Oravec, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia; Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23198 (INIS-mf—10589, pp 110-111) **Decontamination factor determination for adsorption filters in nuclear power plants.** Moravek, J.; Pietrik, I.; Janecka, S. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23199 **(JINR—8-85-756) Electron apparatus complex to examine the superconductor magnet on the heat model.** Inkin, V.D.; Minashkin, V.F.; Filippov, Yu.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701409.

The apparatus structure and the composition to investigate the heat transfer to the two-phase helium flow on the thermomodel are described (TM). The TM is composed of a few low-inertioned thermo-apportionnement elements (TAE), serving at a time as thermosensors. The elaborated power amplifier (PA) feeds every TAE. The PA has two stabilization regimes - power stabilization and voltage stabilization. It assures the apportionnement of the specific power in TAE in the range from 100 to 5000 W/m/sup 2/. The duration of the front power pulse boundary with load is <= 20 ms. The accuracy of the PA power stabilization is less than 4%. The resistance measurement error of the TAE is less than 4%. The program packet is composed of first display programs, of control, treatment and information exit. 10 refs.; 4 figs.

23200 **(NUREG/CR—4776) Response of seismic category I tanks to earthquake excitation.** Butler, T.A.; Bennett, J.G.; Babcock, C.D.; Natsiavas, S. (Los Alamos National Lab., NM (USA); California Inst. of Tech., Pasadena (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight). Feb 1987. Contract W-7405-ENG-36. 67p. (LA—10871-MS). NTIS, PC A04/MF A01. File Number TI87006653.

The response of vertical, above-ground, fluid-filled tanks to seismic loads is reviewed and licensing criteria are recommended for use by the US Nuclear Regulatory Commission in assessing the safety of seismic Category I tanks. Analysis methods and relevant experiments are first reviewed to provide a basis for recommending analytical techniques that are useful for tank safety evaluation. Next, field damage that has occurred during several earthquakes, starting with the 1964 Great Alaska Earthquake, are reviewed ad the damage is categorized. This information is then used, along with experimental evidence, to assess the adequacy of current formal design codes. Finally, a procedure for Category I tank evaluation is recommended and topics that need additional research are identified.

23201 **(PB—87-130456/XAB) Development of a high-strength high-manganese stainless steel for cryogenic use.** Suemune, K.; Sugino, K.; Masumoto, H.; Shimamoto, S.; Nakajima, H. (Nippon Steel Corp., Tokyo). 1986. 6p. NTIS, PC PC E05/MF E01.

Included in Nippon Steel Technical Report, No. 28, 23-28(Jan 1986).

Structural materials for the superconducting magnets of fusion reactors must exhibit very high strength and toughness at cryogenic temperatures, as represented by a yield strength of over 1,200 MPa and KIC value of more than 200-MPa (square root of m) at 4K, and also possess corrosion resistance and nonmagnetism. A study was made to develop a new structural steel with a high-manganese austenitic phase as base. As a result, a 0.05%C-0.3%Si-25%Mn-15%Cr-1%Cu-1%Ni-0.2%N-Ca(Nb) steel was found to meet the requred properties. The addition of about 1%Mo eliminates the decline of low-temperature toughness when the steel is sensitized and is effective in improving the toughness of the heat-affected zone of welds, etc.

23202 **(PNL-SA—14580) System cost-effectiveness for increasing cask shielding.** Smith, R.I. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 4p. (CONF-870306—37). NTIS, PC A02. File Number DE87006433.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

A methodology is developed for evaluating the cost-effectivensss for the federal waste management system of reducing the aggregate system radiation dose by increasing shielding on spent fuel transport casks. The mthodology is evaluated for 100-ton rail casks which utilize steel, lead, and depleted uranium, respectively, for gamma shielding. For these examples, reducing the external radiation dose rate from the casks to less than one-half the current DOT limit does not appear to be cost-effective.

23203 **(RFP—3814) Control systems development, research and development: Annual progress report, October 1983 through September 1984.** Bailey, L.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 31 Jul 1986. Contract AC04-76DP03533. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005785.

This report describes design and implementation of several computerized control systems. These implementations include: an ultrasonic weld tester, an automated vacuum oven, a differential pressure gaging system, a die casting control system, a lathe crash prevention and monitoring system, an electric eddy current weld scanner, a bar code scanner, a gage controller, and thermocouple tester. (JDH)

23204 **(UCRL—95101) Evaluation of the performance of one-way valves used in chemical-protective suits.** Swearengen, P.M.; Johnson, J.S.; Sackett, C.R.; Stull, J.O. (Lawrence Livermore National Lab., CA (USA); Coast Guard, Washington, DC (USA)). 1987. Contract W-7405-ENG-48. 16p. (CONF-870160—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006452.

From American Society for Testing and Materials symposium; Tampa, FL, USA (19 Jan 1987).

We are reporting preliminary results from a study on low-pressure vent valves that we are conducting for the US Coast Guard. Test results from four valves will be discussed here. The valve currently used in the Coast Guard totally-encapsulating chemical-protective (TECP) suit is made by Stratotech Corporation. A second suit valve that was evaluated is made in Sweden by Trelleborg. Then, to provide a comparison for the evaluation, we included two valves that are used in respirators. These valves, made by MSA Corporation, included a standard flapper valve and a pressure demand valve. 4 refs., 6 figs.

23205 **(UCRL—95613) Computational and experimental short-pulse, high-power microwave breakdown in a low-pressure, air-filled rectangular waveguide.** Mayhall, D.J.; Yee, J.H.; Alvarez, R.A.; Byrne, D.P. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 22p. (CONF-861240—13). NTIS MF A01; 2; GPO Dep. File Number DE87006693.

From 3. national conference on high power microwave technology for defense applications; Albuquerque, NM, USA (1 Dec 1986).

This paper reports on experiments conducted to verify the accuracy of computer models of atmospheric microwave attenuation. Measurements were made of 2.856 GHz TE_{10} breakdown in a waveguide. The measurements were compared to one-dimensional computer calculations. Disagreements were found between measured and computed values, so a two-dimensional model was used. The two-dimensional calculations were found to agree with the experiment much better than the one-dimensional calculations. (JDH)

23206 **Experimental tests for the quantum behavior of a macroscopic degree of freedom: The phase difference across a Josephson junction.** Martinis, J.M.; Devoret, M.H.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720; Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **35**: No. 10, 4682-4698(1 Apr 1987). Contract AC03-76SF00098.

Experiments are described that demonstrate the quantum behavior of a macroscopic degree of freedom, namely the phase difference δ across a current-biased Josephson tunnel junction. The behavior of δ was deduced from measurements of the escape rate Γ of the junction from its zero-voltage state. The relevant parameters of the junction, that is, its critical current and shunting admittance, were determined in situ in the thermal regime from the dependence of Γ on bias current and from resonant activation in the presence of microwaves. It was found that the shunting capacitance was dominated by the self-capacitance of the junction while the shunting conductance was dominated by the bias circuitry. For an underdamped junction in the quantum regime, Γ became independent of temperature at low temperatures with a value that, with no adjustable parameters, was in excellent agreement with predictions for macroscopic quantum tunneling at $T = 0$. When the critical current was reduced with a magnetic field so that the junction remained in the thermal regime at low temperatures, Γ followed the predictions of the thermal model, thereby showing the influence of extraneous noise to be negligible. In a further series of experiments, the existence of quantized energy levels in the potential well of the junction was demonstrated spectroscopically. The positions of the energy levels agreed quantitatively with quantum-mechanical predictions involving junction parameters measured in the thermal regime. The relative heights and widths of the resonances are in reasonable agreement with the predictions of a simple model.

23207 **Pushrod assembly.** Potter, J.D. (to Dept. of Energy, Washington, DC). US Patent 4,645,639. 24 Feb 1987. Filed date 30 Mar 1984. vp.

A pushrod assembly is described comprising: a frame, a shaft mounted on the frame, a carriage mounted on the shaft for reciprocal movement therealong, a pushrod mounted on the carriage and movable therewith for urging a load in a linear path, a magnet, means slidably mounted on the shaft for supporting the magnet, and means for moving the supporting means. It also comprises a means for spacing the carriage from the magnet to establish a selected magnetic coupling force therebetween causing the carriage to follow the magnet upon movement of the supporting means away from the carriage, and means for adjusting the spacing between the magnet and the carriage for varying the magnetic coupling force therebetween. The carriage is decoupled from the supporting means upon encountering a resistance force exceeding the selected magnetic coupling force.

23208 **Magnetic refrigeration apparatus with heat pipes.** Barclay, J.A.; Coyne, F. (to Dept. of Energy, Washington, DC). US Patent 4,642,994. 17 Feb 1987. Filed date 25 Oct 1985. vp.

This patent describes an about 4 to about 20 K. refrigeration apparatus comprising: a magnetic field generating means; a fluid contactable magnetic material interacting with the magnetic field produced by the magnetic field generating means so as to be subjected to a cyclically time varying magnetic field; a fluid effective to transfer heat at temperatures between about 4 and about 20K.; an external heat sink; and at least two directional heat pipes, one such pipe disposed between the fluid and the object of cooling whereby heat from the object of cooling is transmitted through the fluid to the magnetic material when the magnetic material absorbs heat. Another such pipe is disposed between the fluid and the external heat sink whereby heat from the magnetic material when the magnetic material is rejecting heat is transmitted through the fluid to the external heat sink, and also whereby the heat from the hot ends of the directional heat pipes is minimally transmitted to the cold ends of the directional heat pipes.

23209 **Chip breaking system for automated machine tool.** Arehart, T.A.; Carey, D.O. (to Dept. of Energy, Washington, DC). US Patent 4,643,056. 17 Feb 1987. Filed date 7 Jan 1986. vp.

A chip-breaking system is described in combination with an automated machining apparatus wherein a rotatable turret having a plurality of circumferentially spaced apart stations each supporting machine tool means is selectively rotated about an axis for positioning one of the machine tool means in a material-removing relationship with a work piece. The chip-breaking system comprises nozzle

means carried by each of the machine tool means, a valve assembly comprising manifold means supported by the turret for rotation therewith about the axis and having circumferentially spaced apart passageways therein, header means carried by the manifold means and relatively stationary with respect thereto. The manifold means and the header means respectively comprise first and second plate means longitudinally positioned on the rotational axis and have contiguously disposed planar surfaces located therebetween with each of the passageways being radially spaced from the axis and having one end thereof of registry with the planar surface on the first plate means.

23210 **Gas dynamics in residual gas analyzer calibration.** Santeler, D.J. (Process Applications, Inc., Oak Ridge, Tennessee 37830). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 1, 129-133(Jan 1987).

Residual gas analyzers are used for measuring partial flow rates as well as for measuring partial pressures. The required calibration may also be obtained with either known flow rates or known pressures. The calibration and application procedures are straightforward when both are of the same type; however, substantial errors may occur if the two types are mixed. This report develops the basic equations required to convert between partial pressure calibrations and partial flow rate calibrations. It also discusses the question of fractionating and nonfractionating gas flow in various gas inlet and pumping systems.

23211 **(OA-Trans—3269) Channel-type electric induction furnace.** (Overseas Relations Branch Translation Service, London (UK)). Sep 1986. Translation of French Patent No. 1 359 528, 16 March 1964. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900021.

The invention is a channel-type electric induction furnace which envelops the chamber of a furnace or hearth and one or more channels in a loop. The aim is to obtain circulation of molten metal in the channel in the same direction, at a flow rate that avoids temperature excesses while fully maintaining the advantageous properties of the channel furnace.

4203 Lasers

REFER ALSO TO CITATION(S) 22954, 22955, 24143

23212 **(AD-A—175696/4/XAB) Simple laser-driven, metal photocathodes as cold, high-current electron sources. Master's thesis.** Saunders, J.D. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1986. 39p. NTIS, PC A03/MF A01.

Recent developments in excimer laser design have made near ultraviolet light intensities of several megawatts/cm^2 possible in unfocused beams. These advances and recent experiments indicate that high-current, simple-metal photoemissive electron guns are now feasible. Such guns should produce greater then 50 amps/cm^2 of illuminated cathode surface. Additionally, these guns could operate at vacuums of .000001 torr with no complicated system components inside the vacuum enclosure. The electron beam produced by such photoemission guns would have a very low emittance and high brightness. This beam would also follow closely the temporal characteristics of the laser pulse, making fast risetime, ultra-short electron-beam pulses possible.

23213 **(ANL-HEP-CP—86-132) Why gamma rays are different: Some notes for pedestrians.** Lipkin, H.J. (Argonne National Lab., IL (USA)). 24 Oct 1986. Contract W-31109-ENG-38. 10p. (CONF-861038—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004963.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

This paper is a critical analysis of some of the problems facing gamma ray laser construction. The physics of optical lasers is compared to that of gasers. The manner in which gamma-ray emission is stimulated is very different from light-emission stimulation in optical lasers. It is concluded that the differences in stimulation methods make effective gaser construction very difficult. (JDA)

23214 **(DOE/DP/40200—35) Practical measurements of adhesion and strain for improved optical coatings.** Jacobs, S.D.; Hayden, J.E.; Hrycin, A.L. (Rochester Univ., NY (USA). Lab. for Laser Energetics; Eastman Kodak Co., Rochester, NY (USA)). 1986. Contract FC08-85DP40200. 13p. (CONF-860880—48). NTIS, PC A02. File Number DE87005918.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Adhesion and strain are two important physical properties which determine the success or failure of thin-film coatings in optical applications. In this paper we describe the design and operation of a dynamically loaded scratch tester for making measurements of relative adhesive strength, and a modulated transmission ellipsometer for measuring total and internal strain. Numerous examples for coating/substrate systems of interest to optical applications are given.

23215 **(EUR—9708-Vol.2, pp 713-732) XUV lasers. A review.** Pert, G.J. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A review is given of the present state of the art in generating XUV laser action, with emphasis on methods utilising plasma as source. An introductory analysis identifies the principal problems due to pump power scaling, materials and physical size. The most promising proposals at present being studied are examined, and current experimental programmes identified.

23216 **(UCRL—15867-Vol.1) New laser materials: Final report, January 1985-December 1985.** (Allied Corp., Morristown, NJ (USA); Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006722.

Our work during the contract year can be roughly divided into three phases: The initial phase involved the re-evaluation of a list of compounds synthesized at Allied prior to the present contract. A list of such compounds was included in the first interim report (February-April 1985). Candidates identified as potential laser materials were further investigated. Iso-structures of some known compounds were also grown and studied in the second phase. These compounds included $LaScO_3$, Mg_2SiO_4 (forsterite), $ZnGa_2O_4$, $CdGa_2O_4$ and $Ga_2(WO_4)_3$. The third phase consisted of the synthesis of new materials. A notable example is Cr doped $ScBO_3$, the first reported borate crystal tunable laser host. Room temperature tunable laser action was demonstrated. Other new materials investigated include $InBO_3$, YBO_3, $NaAlP_2O_7$ and $CaAl_2O_4$. The following report consists of two main sections, spectroscopy and materials synthesis.

23217 **(UCRL—52000-86-12) Energy and technology review.** Cabayan, H.S.; Eccles, S.F.; Adye, P.; Clements, W.; Crawford, R.B.; de Vore, L.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Van Dyke, P.T. (eds.). (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006586.

Separate abstracts were prepared for six articles in this review. (LEW)

23218 **(UCRL—95706) Time and space resolved spectroscopy of x-ray laser experiments from 81A to 220 A.** Ceglio, N.M.; Medecki, H. (Lawrence Livermore National Lab., CA (USA)). 12 Jan 1987. Contract W-7405-ENG-48. 12p. (CONF-860880—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005946.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Data are presented from three different x-ray laser inversion schemes tested on the Novette laser facility at LLNL: collisional excitation of neon-like selenium (λ = 206, 209, 220A); resonant photoexcitation of hydrogen-like fluorine (λ = 81A); and recombination of hydrogen-like magnesium (λ = 130A). The data illustrate the measurement capabilities of a new, time resolved imaging spectrometer (TGSS-EM), and provide insight to the dynamics and emission characteristics of a new class of laser produced plasmas.

23219 **Free electron lasers.** Colson, W.B.; Sessler, A.M. (Berkeley Research Associates, P.O. Box 241, Berkeley, California 94701). *Annual Review of Nuclear Science;* **35**: No. 1, 25-54(1985).

A brief review is given of the principles of the free electron laser. Among the topics covered are electron beam bunching, applications, historical aspects, and undulator design. (AIP)

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 22515, 22558, 22614

23220 **(ANL—86-48) Motion-dependent fluid forces acting on a tube row in crossflow.** Jendrzejczyk, J.A.; Chen, S.S. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005574.

Motion-dependent fluid forces acting on a tube row with a pitch-to-diameter ratio of 1.35 are measured for several flow velocities and a series of oscillation frequencies. Fluid-damping and fluid-stiffness coefficients are obtained from motion-dependent fluid forces as a function of reduced flow velocity. Fluid-force coefficients agree reasonably with published data. Based on the fluid-force coefficients, the critical flow velocity and instability characteristics of tube arrays in crossflow can be predicted.

23221 **(EGG-M—14586) Bench mark numerical problems.** Ransom, V.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 26p. (CONF-870320—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013480.

From Department of Energy international workshop on two-phase flow fundamentals; Troy, NY, USA (16 Mar 1987).

This paper presents three problems in the study of two-phase flow. The first problem is steady "faucet" flow - liquid flow in a vertical column. The analytical solution is compared to the numerical solution. The second problem is the oscillating manometer. The analytical solution is compared with a typical numerical solution. The final problem presented is injection of subcooled water into a superheated steam. There is no analytical solution for this problem. (JDH)

23222 **(GKSS—86/E/36) Parameterization of flows with helicity.** Lautenschlager, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften). 1986. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751212.

A parameterization of the turbulent fluxes in the Navier-Stokes equations will be suggested which includes not only diffusive properties of turbulence but also assumes orderly structures to be possible in turbulence. The orderly structure measured by the turbulent helicity is the 'Schraubensinn' of the turbulent eddies. It will be shown the terms of the new parameterization stabilize a model vortex. In the limit of vanishing eddy orientation (turbulent helicity approaches zero) the new parameterization reproduces the diffusion parameterization.

23223 **(Juel—2071) Flow and heat-transfer at the intake of a radially symmetrical longitudinal flow heat exchanger.** Cronenbroeck, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Technische Hochschule Aachen (Germany, F.R.)). Jul 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751213.

At the admission section of a radially symmetrical longitudinal flow heat exchanger, cross flow of the tubes occurs. The cross flow is followed by an inclined flow, which turns over to a well-balanced longitudinal flow along the tubes. At two heat exchanger models (tube pitch S/sub Δ/ = 1.5, S/sub Δ/ = 2.0) the velocity distribution, the pressure-drop and the heat-transfer is determined experimentally. By the variation of the boundary-conditions, the influence of the geometry, the mass flow, the tube pitch and the position of the first spacer is shown in this investigation. Finally the experimental datas are compared with results of calculations.

23224 **(Juel-Spez—362) Use of the Laser-Doppler-Anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger.** Cronenbroeck, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jul 1986. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751186.

The Laser-Doppler-Anemometry (LDA) is an optical technic to measure flow velocities. In this report the principles of this method as well as the LDA-system components are described. Especially the signal-processing and the special conditions of use are discussed. The measurement of a two-dimensional velocity distribution at the intake of a longitudinal flow heat exchanger is shown in this investigation.

23225 **(NORDITA—85/27-Prepr.) Effect of a convex boundary on a rarefied classical- or quantum gas. Flow past a stationary boundary and the effect of an oscillating boundary on the gas.** Beyer, J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Jul 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751244.

The effect of a stationary solid body on the flow of rarefied gases is considered. We also consider the effect of an oscillating solid body on a rarefied gas. For a gas of particles of arbitrary statistics we derive coupled integral equations for the chemical potential, velocity field and temperature. We show that the stationary value of a functional is closely related to the drag exerted on the body. When the mean free path is much larger than a typical dimension of the body, we show that the drag is given by a simple surface integral.

23226 **(VTT-TUTK—421) Flow-rate measurement using radioactive tracers and transit time method.** Turtiainen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1986. 86p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750890.

The transit time method is a flow measurement method based on tracer techniques. Measurement is done by injecting to the flow a pulse of tracer and measuring its transit time between two detection positions. From the transit time the mean flow velosity and - using the pipe cross section area - the volume flow rate can be calculated. When a radioisotope tracer is used the measurement can be done from outside the pipe and without disturbing the process (excluding the tracer injection). The use of the transit time method has been limited because of difficulties associated with handling and availability of radioactive tracers and lack of equipment suitable for routine use in industrial environments. The purpose of this study was to find out if these difficulties may be overcome by using a portable isotope generator as a tracer source and automating the measurement. In the study a test rig and measuring equipment based on the use of a "1"3"7Cs/"1"3"7""mBa isotope generator were constructed. They were used to study the accuracy and error sources of the method and to compare different algorithms to calculate the transit time. The usability of the method and the equipment in industrial environments were studied by carrying out over 20 flow measurements in paper and pulp mills. On the basis of the results of the study, a project for constructing a compact radiatracer flowmeter for industrial use has been started. The application range of this kind of meter is very large. The most obvious applications are in situ calibration of flowmeters, material and energy balance studies, process equipment analyses (e.g. pump efficiency analyses). At the moment tracer techniques are the only methods applicable to these measurements on-line and with sufficient accuracy.

23227 Natural convection from horizontal wires to viscoelastic fluids. Ng, M.L.; Harnett, J.P.; Kwack, E.Y. (Fellow ASME). *Journal of Heat Transfer;* **108**: No. 4, 790-795(Nov 1986).

Natural convection heat transfer from horizontal wires of three different diameters (0.0254, 0.0508, and 0.0826 cm) to a pool of viscoelastic liquid was studied. Aqueous solutions of Natrosol and Polyox constituted the viscoelastic test fluids. The experimental Nusselt numbers were found to agree with the correlations recommended by Fand and Brucker for Newtonian fluids if the zero shear rate viscosity is used in the Rayleigh and Prandtl numbers.

23228 Mechanics and applications of enthalpy-radiation energy conversion. Yang, W.J. (Dept. of Mechanical Engineering and Applied Mechanics, Univ. of Michigan, Ann Arbor, MI 48109). pp 39-67 of Proceedings of the eighth annual energy seminar. Erie, PA; Gannon University College of Science (1986). (CONF-860336—).

From 8. annual energy seminar; Erie, PA, USA (18 Mar 1986).

When a porous layer of fine matrix texture and high porosity is placed in a hot stream, fluid enthalpy is converted into radiative energy which is irradiated in the upstream direction of the flow. Two fundamental concepts pertinent to the enthalpy-radiation energy conversion are introduced: the mechanics of energy recirculation and thermal insulation in flow streams. Theory on the energy conversion is presented and the governing dimensionless parameters are identified. Theory is substantiated by experiments. Applications of the energy conversion are demonstrated in heat recovery.

23229 (SAND—87-6000) Impact of a two-dimensional gas flow against an infinite wall. Slezkin, N.A. Translated from *Prikladnaya Matematika i Mekhanika ;* **16**: 127-130(1952). Contract AC04-76DP00789. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006396.

This paper uses conformal mapping to construct a formal solution to the problem of a gas flow striking an infinite plane. The gas is assumed to be ideal and incompressible. It is also assumed that the mainstream velocity is perpendicular to the plane at infinity. (JDH)

4205 Materials Testing

REFER ALSO TO CITATION(S) 22470, 22858, 22887, 24261

23230 (IAN-AIM—5) Industrial radiography X and gamma. Torres M, N.; Torres B, M.; Montanez, J. (Instituto de Asuntos Nucleares, Bogota (Colombia). Area de Aplicaciones Industriales y Metalurgia). Apr 1986. 76p. (In Spanish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701518.

This publication gives a practical orientation on industrial radiography. The first chapters deal with basic facts that are useful for professional work in this field. It comprises topics such as generation of X-rays, equipment being used, radiographic films, sensibility, and the penetrameters used. This publication also describes the most used radiographic techniques and the processing of the radiographic film. It contains practical recommendations on how to obtain a good radiographic inspection. It states the reasons for defects in the radiographies. Two annexes are attached which include tables for the selection of penetrameters according to the ASME and DIN codes as well as the time needed for development and fixing according to the temperature.

23231 (INIS-BR—581) Fluoroscopic inspection in the non-destructive testing of material today- and tomorrow. Bohnsack, G. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1985. 8p. (CONF-8509375—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701620.

From 6. Brazilian seminar of non-destructive tests; Belo Horizonte, Brazil (1 Sep 1985).

A lot of articles in NDT-magazines and reports at NDT-meetings deal with the problems of fluoroscopy, i.e. real time imaging. All of them give theoretical information of conversion factors, line pair sensitivity, input/output, but very few of them give practical hints regarding application for this 'NDT-Toll' which is more and more used in nearly in industrial fields. The imaging systems to be combined with x-ray systems are presented. The aspects of practical use in modern industry are discussed.

23232 (INIS-BR—582) Why and how acoustic emission in pressure vessel first hydrotest. Panzani, C.; Tonolini, F.; Villa, G.; Regis, V. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1985. 21p. (CONF-8509375—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701621.

From 6. Brazilian seminar of non-destructive tests; Belo Horizonte, Brazil (1 Sep 1985).

The main advantages obtained performing the Acoustic Emission (AE) examination during pressure vessel first hydrotest are presented. The characteristics and performance of the AE instrumentation to be used for a correct test are illustrated. The main criteria for AE source characterization (location, typical AE parameters and their correlation with pressure value), the calibration and test procedures are discussed. The ndt post-test examinations and laboratory specimen experiments are also outlined. Personnel qualification requirements are finally indicated.

23233 (RISO-M—2575) Reference neutron radiographs of nuclear reactor fuel. Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 12p. (CONF-8606235—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750669.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

Reference neutron radiographs of nuclear reactor fuel were produced by the Euratom Neutron Radiography Working Group and published in 1984 by the Reidel Publishing Company. In this collection a claccification is given if the various neutron radiographic findings, that can occur in different parts of pelletized, annular and vibro-compacted nuclear fuel pins. Those parts of the pins are shown where changes of appearance differ from those for the parts as fabricated. Also radiographs of those as fabricated parts are included. The collection contains 158 neutron radiographs, reproduced on photographic paper (twice enlarged) and on duplicating film (original size).

23234 (RISO-M—2576) Euratom neutron radiography working group. Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 17p. (CONF-8606235—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750668.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

In 1979 a Neutron Radiography Working Group (NRWG) was constituted within Euratom with the participation of all centers within the European Community at which neutron facilities were available. The main purpose of NRWG was to standardize methods and procedures used in neutron radiography of nuclear reactor fuel as well as establish standards for radiographic image quality of neutron radiographs. The NRWG meets once a year in each of the neutron radiography centers to review the progress made and draw plans for the future. Besides, ad-hoc sub-groups on different topics within the field of neutron radiography are constituted. This paper reviews the activities and achievements of the NRWG and its subgroups.

23235 (RISO-M—2577) International neutron radiography newsletter. Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 8p. (CONF-8606235—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750667.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

At the First World Conference on Neutron Radiography it was decided to continue the 'Neutron Radiography Newsletter', published previously by J.P. Barton, as the 'International Neutron Radiography Newsletter' (INRNL), with J.C. Domanus as editor. The British Journal of Non-Desctructive Testing (BJNDT) has agreed to publish the INRNL in its column 'NDT Bookcase'. The

Revue Practique de Control Industriel has also agreed to publish the French version of the INRNL. Up till now 12 issues of the INRNL were published in the BJNDT. They are reviewed below.

23236 **(RISO-M—2578) Assessment of radiographic image quality by visual examination of neutron radiographs of the calibration fuel pin.** Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 11p. (CONF-8606235—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750666.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

Up till now no reliable radiographic image quality standards exist for neutron radiography of nuclear reactor fuel. Under the Euratom Neutron Radiography Working Group (NRWG) Test Program neutron radiographs were produced at different neutron radiography facilities within the European Community of a calibration fuel pin. The radiographs were made by the direct, transfer and tracketch methods using different film recording materials. These neutron radiographs of the calibration fuel pin were used for the assessment of radiographic image quality. This was done by visual examination of the radiographs and assessing their radiographic image quality on an arbitrary scale.

23237 **(RISO-M—2579) Can neutron beam components and radiographic image quality be determined by the use of beam purity and sensitive indicators?.** Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Apr 1986. 18p. (CONF-8606235—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750665.

From 2. world conference on neutron radiography; Paris, France (16 Jun 1986).

In the Euratom Neutron Radiography Working Group Test Program beam purity and sensitivity indicators, as prescribed by the ASTM E 545-81 were used together with the NRWG beam purity indicator-fuel and calibration fuel pin. They were radiographed together at neutron radiography facilities of the European Community. The direct, transfer and track-etch methods using different film recording materials were used. Neutron beam components were calculated from film density measurements under the beam purity indicators and radiographic image quality was assessed by visual examination of the sensitivity indicator. Results obtained under the NRWG Test Program are summarized and compared.

23238 **Neutron tomography of damaged fuel assemblies.** McClellan, G.C.; Tow, D.M. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 182-183(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Neutron tomography is a three-dimensional imaging technique developed at Argonne National Laboratory's Hot Fuel Examination Facility (HFEF) for use in the nondestructive evaluation of reactor fuel assemblies, including those deliberately damaged to simulate accident conditions. Such damaged fuel assemblies are typically irradiated under abnormally severe conditions, resulting in cladding melting and fuel dispersion. This neutron tomography capability is the result of a cooperative effort between Argonne National Laboratory-West and EG & G Idaho, Inc., which are both located at the Idaho National Engineering Laboratory (INEL). Neutron tomography consists of the following basic steps: (a) neutron radiographs are made of the fuel assembly at many angles, (b) these radiographs are then digitized to convert the film density data to digital data, and (c) the digital data set is then used to produce computer-generated cross-sectional representations of the assembly. These cross-sectional images can be generated at any desired axial location and provide early assessment of fuel assembly damage and failure mechanisms without risking displacement of the internal components by cutting. In fact, neutron tomography reduces or even eliminates the need to conduct costly and time-consuming destructive examination of the assemblies.

23239 **Estimation for a Weibull accelerated life testing model.** Glaser, R.E. (Lawrence Livermore National Lab., CA). *Naval Research Logistics Quarterly;* **31**: 559-570(1984). Contract W-7405-ENG-48.

It is sometimes reasonable to assume that the lifetime distribution of an item belongs to a certain parametric family, and that actual parameter values depend upon the testing environment of the item. In the two-parameter Weibull family setting, suppose both the shape and scale parameters are expressible as functions of the testing environment. For various models of functional dependency on environment, maximum likelihood methods are used to estimate characteristics of interest at specified environmental levels. The methodology presented handles exact, censored, and grouped data. A detailed accelerated life testing analysis of stress-rupture data for Kevlar/epoxy composites is given. 10 references, 1 figure, 2 tables.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 22958, 22962, 23377, 23383

23240 **(BDX—613-3670) Baseline characterization of 4/3 technology large-scale integrated circuit photolithography processes on underlying oxide and polysilicon substrates: Topical report.** Jakubczak, J.F.; Sobering, J.M. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Feb 1987. Contract AC04-76DP00613. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006580.

The patterning of resist images during the fabrication of integrated circuits involves many variables which were investigated through the characterization of an existing 4/3 μm technology lithography operating window for polysilicon and oxide films. The major variables affecting resist thickness are discussed and the results of variations in resist thickness are evaluated. Focus and exposure latitudes are defined at and near the present operating point. The resist develop process is evaluated and the overall resist system response is measured by defining the resist exposure threshold energy and system contrast.

23241 **(LA-UR—87-383) The structure of constitutive equations for semiconductor devices.** Buchanan, G.R.; Girrens, S.P.; Bennett, J.G. (Tennessee Technological Univ., Cookeville (USA). Dept. of Civil Engineering; Los Alamos National Lab., NM (USA)). Jan 1987. Contract W-7405-ENG-36. 8p. (CONF-870103—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006052.

From 2. international conference on constitutive laws for engineering materials; Tucson, AZ, USA (5 Jan 1987).

The fundamental equations that describe carrier transport in semiconductor materials are developed using the methods of continuum mixture theory and Maxwell's equations for electrodynamics. There are five basic equations that govern the behavior of current flux, electrostatic potential, electrons, and holes. The bahavior of the electrical chemical potentials are introduced and their relation to the current flux is discussed.

23242 **(LBL—22878) Fatigue and thermal fatigue testing of Pb-Sn solder joints.** Frear, D.; Grivas, D.; McCormack, M.; Tribula, D.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 21p. (CONF-870486—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006938.

From 3. annual electronic packaging conference; Minneapolis, MN, USA (27 Apr 1987).

In an electronic package, materials of different thermal expansion coefficients are usually joined with Pb-Sn solder. The combination of temperature fluctuations and different thermal expansion coefficients creates a condition of thermal fatigue in the solder joints. This paper presents a discussion of experimental techniques developed to study fatigue in solder joints. Specimens have been developed to reproducibly test solder joints in shear using a modified double lap shear configuration. Tests were performed using a digital loadframe especially designed to isothermally fatigue solder joints in shear. Joints tested had a nominal solder composition of 60Sn-40Pb soldered to Cu. Failures were found to occur in the solder joint after fewer cycles at 125°C than at lower temperatures. Solder joints were also tested in shear thermal fatigue. A specimen design consisting of two materials with different thermal expansion coefficients constraining a solder joint was cycled between -55°C and 125°C. Results of these tests indicate that there is a coarsening

of the solder near the joint interface and fatigue cracks initiate in these coarsened regions.

23243 (PB—87-134532/XAB) Documentation of computer programs for optimization and simulation of multicarrier SAW-based demodulator. Bakken, P.M.; Lier, E. (Norges Tekniske Hoegskole, Trondheim. Electronics Research Lab.). Jan 1986. 50p. NTIS, PC PC E04/MF E04.

Published as Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway) rept. no. STF44-A86005.

The report describes computer methods to optimize the receiver filter in a communication system when certain limitations on filter design is imposed. The method is applied to two designs of SAW-based multicarrier demodulators where the receive filter impulse responses are limited in time duration. The optimization is carried out by a general optimization routine, while software has been developed to model the transmitted signal and the equivalent filter function of the SAW-based receiver. The results have been confirmed by simulation, and can be useful to a wide range of related problems (e.g. array antennas).

23244 (SAND—86-1945C) Extrinsic gettering for VLSI/ULSI processes. Medernach, J.W.; Witherspoon, L.L. (Sandia National Labs., Albuquerque, NM (USA); KMI, Inc., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 2p. (CONF-870513—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002696.

From 171. Electrochemical Society meeting; Philadelphia, PA, USA (10 May 1987).

Gettering techniques are employed to reduce metallic impurities that can be accumulated during device processing. The removal of these metallic impurities from active device regions improves device yield, oxide integrity, and other device parameters. Intrinsic (IG) and extrinsic (EG) gettering techiques are reported to be effective, but may not be as effective for small geometry processing because of possible problems regarding reproducibility and uniformity of oxygen precipitation phenomena. Object of this investigation was to develop an EG technique in which a uniform internal defect formation is formed for a n/n^+ epitaxial structure. The use of medium and high oxygen content n^+ substrates with and without poly/nitride EG layers for a 2.0μm to 1.0 μm p-well CMOS process is reported.

23245 Fast pulse response of zinc-oxide varistors. Modine, F.A.; Wheeler, R.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **61**: No. 8, 3093-3098(15 Apr 1987). Contract AC05-84OR21400.

The fast pulse response of zinc-oxide varistors is studied for both high-impedance and low-impedance pulse sources. The effects of varistor capacitance and source impedance on the pulse response are examined, and quantitative descriptions of the pulse response are presented. Evidence that the varistor capacitance does not increase near breakdown voltages is found, and the implications of this result with regard to models of varistor conduction are discussed. The relationships between the properties of a varistor and its ability to protect against fast pulses are considered.

23246 Stabilized chromium oxide film. Nyaiesh, A.R.; Garwin, E.L. (to Dept. of Energy). US Patent Application 6-893,056. 4 Aug 1986. 28p. Contract AC03-76SF00515. DE87007204 NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007204.

Stabilized air-oxidized chromium films deposited on high-power klystron ceramic windows and sleeves having a thickness between 20 and 150A are useful in lowering secondary electron emission yield and in avoiding multipactoring and window failure due to overheating. The ceramic substrate for the film is chosen from alumina, sapphire or beryllium oxide.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 22170, 22435, 23186

23247 (AD-A—175762/4/XAB) Fluidized-bed boiler assessment for Navy applications. Final report, October 1983-September 1985. Fu, T.T.; Maga, G.F. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Nov 1986. 48p. (NCEL-TN—1761). NTIS, PC A03/MF A01.

This report discusses the assessment of one of the most-promising coal-firing technologies - Fluidized-Bed Combustion(FBC) - for Navy stationary boilers. The working principles, physical construction, major and auxiliary components, and system performance of an FBC boiler are described and compared with the conventional stoker and pulverized-coal fired boilers. The advantages of the FBC boiler based on fuel flexibility, operational reliability, economic feasibility, and environmental acceptability are identified, state-of-development and FBC manufacturers are also noted. The problems with the Great Lakes FBC boiler plant were studied and possible remedial measures are given. Considerations for FBC retrofitting have been examined based on boiler size, age, configuration, accessory components, and available space. Recommendations on how to achieve the Navy's goal of coal utilization by the FBC approach are outlined.

23248 (PB—87-136800/XAB) Fossil and nonfossil fuel-fired industrial boilers - background information for promulgated PM (particulate matter) and NOx (nitrogen oxide) standards. Volume 3. Final environmental impact statement. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Oct 1986. 82p. (EPA—450/3-86/003). NTIS, PC A05/MF A01.

The document summarizes the comments received on the proposed New Source Performance Standards (NSPS) controlling particulate matter and nitrogen oxide emissions from new, modified, and reconstructed industrial-commercial-institutional boilers (49 FR 25102). Additionally, the document contains a summary of the final standards and the environmental impacts of the final standards.

23249 (PB—87-140323/XAB) Pilot-scale process evaluation of reburning for in-furnace NOx reduction. Final report, October 1984-October 1985. McCarthy, J.M.; Overmoe, B.J.; Chen, S.L.; Seeker, W.R.; Pershing, D.W. (Energy and Environmental Research Corp., Irvine, CA (USA)). Dec 1986. 189p. NTIS, PC A09/MF A01.

This report gives results of coal and natural gas reburning application tests to a pilot-scale 3.0-MWt furnace to provide the scaling information required for commercial application of reburning to pulverized-coal-fired boilers. Initial parametric studies had been conducted in a 23-kWt bench scale reactor to quantify the impact of fuel and process parameters on reburning effectiveness. The results of this investigation confirm the potential of the reburning process for significant NOx reduction. Process effectiveness depends strongly upon the NOx and O_2 concentrations at the end of the main heat-release zone; the stoichiometry, temperature, and residence time in the fuel-rich reburning zone; the fuel composition and mixing of the reburning fuel jet; and the temperature of the final burnout zone. The investigation also identifies and defines the optimum design criteria for reburning application and demonstrates that it is possible to scale up the process without losing effectiveness.

23250 (PB—87-145637/XAB) Establishment of design criteria for optimum burners for application to heavy-fuel-fired package boilers. Volume 1. Laboratory scale tests. Final report, 1980-1982. England, G.C.; Pershing, D.W.; Heap, M.P. (Energy and Environmental Research Corp., Irvine, CA (USA)). Nov 1986. 124p. NTIS, PC A06/MF A01.

The report gives results of a research program to develop low-NOx heavy-oil burners for application to industrial package boilers. Volume I documents Phase 1 of the program, bench scale studies that defined optimum conditions for two-stage combustion. The information led to a conceptual two-stage low-NOx burner design. Volume II gives results of pilot-scale experiments conduct-

ed in two test facilities with nominal capacities of 0.9 and 2.9 MWt, including tests of commercial burners for both firetube and watertube boilers. A wide range of petroleum-, coal-, and shale-derived fuels were investigated. Tests were also conducted with prototype advanced low-NOx burners which demonstrated that NOx emissions below 100 ppm (corrected to 0% O_2) could be achieved almost independently of the bound nitrogen content in the fuel. The conceptual design was successfully scaled from 21 kWt to 0.9 MWt to 2.9 MWt with similar NOx emissions performance.

23251 **(PB—87-145645/XAB) Establishment of design criteria for optimum burners for application to heavy-fuel-fired package boilers. Volume 2. Pilot scale tests. Final report, 1980-1982.** England, G..; Pershing, D.W.; Heap, M.P. (Energy and Environmental Research Corp., Irvine, CA (USA)). Nov 1986. 158p. NTIS, PC A08/MF A01.

The report gives results of a research program to develop low-NOx heavy-oil burners for application to industrial package boilers. Volume I documents Phase 1 of the program, bench scale studies that defined optimum conditions for two-stage combustion. The information led to a conceptual two-stage low-NOx burner design. Volume II gives results of pilot-scale experiments conducted in two test facilities with nominal capacities of 0.9 and 2.9 MWt, including tests of commercial burners for both firetube and watertube boilers. A wide range of petroleum-, coal-, and shale-derived fuels were investigated. Tests were also conducted with prototype advanced low-NOx burners which demonstrated that NOx emissions below 100 ppm (corrected to 0% O_2) could be achieved almost independently of the bound nitrogen content in the fuel. The conceptual design was successfully scaled from 21 kWt to 0.9 MWt to 2.9 MWt with similar NOx emissions performance.

23252 **(PB—87-152500/XAB) Fundamental studies of calcium-based sorbents for SO_2 control from coal-fired boilers. Final report, October 1983-September 1984.** Cole, J.A.; Kramlich, J.C.; Samuelsen, G.S.; Seeker, W.R.; Silcox, G.D. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jan 1987. 218p. NTIS, PC A10/MF A01.

This report gives results of laboratory-scale controlled-temperature experiments, studying aspects of SO_2 capture by calcium-based sorbents in a flame/gas environment. Experimental parameters were sorbent type, temperature, residence time, and effects of mineral additives (promoters) on sorbent reactivity. The data revealed that isothermal capture is greatest at 1000 C, above which sintering of the sorbent can occur which reduces sorbent utilization. The results suggest that (at ideal sulfation conditions--1000 C, isothermal residence times greater than 1 sec, no deactivation of the sorbent by coal-ash minerals) the best calcium utilizations achievable would be about 25-30% with the raw limestone tested (Vicron 45-3), about 30-35% with the raw dolomite tested, and about 40% with both precalcined dolomite (precalcined to a surface area of 60 sq m/g) and pressure-slaked dolomitic lime. Adding Cr_2O_3, alkali metal salts, and other promoters increased limestone use.

4250 Power Cycles

23253 **(AD-A—175678/2/XAB) Compact-treatment package for acoustic suppression of the standard US DOD 30-kW diesel engine-driven generator set. Final report, November 1983-May 1986.** Remington, P.J.; Rubin, M.N. (BBN Labs., Inc., Cambridge, MA (USA)). May 1986. 152p. (BBN—6255). NTIS, PC A08/MF A01.

This report documents the results of a recent, successful project to develop a retrofit treatment package to reduce the acoustic signature of standard U.S. DOD 30-kW diesel engine-driven generator sets. The treatment resulting from this development reduces the detection distance of such generator sets by a factor of 3 in a compact package.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 23586, 23688

23254 **Physics of particle accelerators: Volume 2.** Month, M.; Dienes, M. (eds.). New York, NY; American Institute of Physics (1987). 723p. (CONF-850771—Vol.2; CONF-840873—Vol.2). American Institute of Physics, 335 E. 45th St., New York, NY 10017. File Number TI87006818.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Separate abstracts were prepared for fifteen papers in this volume, which address accelerator technology and CERN's proton-antiproton collider. (LEW)

23255 **Physics of particle accelerators: Volume 1.** Month, M.; Dienes, M. (eds.). New York, NY; American Institute of Physics (1987). 1064p. (CONF-850771—Vol.1; CONF-840873—Vol.1). American Institute of Physics, 335 E. 45th St., New York, NY 10017. File Number TI87006817.

From SLAC summer school on the physics of high energy particle accelerators; Stanford, CA, USA (15 Jul 1985).

Separate abstracts were prepared for 21 papers in this volume, which address accelerator theory. (LEW)

4301 Design, Development, And Operation

23256 (EUR—9762-Vol.2, pp 989-998) **Progress with the 200 MeV cyclotron facility at the National Accelerator Centre.** Jones, D.T.L. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The 200 MeV separated-sector cyclotron facility of the National Accelerator Centre (NAC) is at present under constraction at Faure, near Cape Town. The multidisciplinary NAC will provide facilities for basic and applied research, radionuclide production and for radiotherapy with neutrons and charged particles. There are three radiotherapy treatment vaults; one will be used for charged particle (mainly proton) therapy, one for neutron therapy while the third will have a horizontal beamline where either modality can be used. The isocentric neutron therapy system which incorporates a variable collimator will produce neutron beams from the p(66 MeV)/Be reaction. This system is due to be completed in early 1985. An isocentric proton beam delivery system incorporating a digital beam scanning system is under consideration. The light ion injector cyclotron is complete while the first beams are expected from the main cyclotron in the latter half of 1985. All the buildings will be completed by November 1984. It is anticipated that the first patients will be treated during 1986.

23257 (EUR—9762-Vol.2, pp 979-988) **University of Texas M.D. Anderson Hospital Cyclotron Facility.** Almond, P.R.; Zermeno, A.; Marbach, J.R.; Otte, V.; Stafford, P.M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The M.D. Anderson Hospital fast neutron facility has been in operation since September 1983. It is based upon a Cyclotron Corporation CP-42 negative proton cyclotron. The protons are transported through beam lines into a berylium target for the production of the neutrons. Two treatment rooms are available, one has a fixed horizontal beam, which while being used primarily for radiobiology and neutron physics experiments, can also be used for patient treatment. The other contains an isocentrically mounted beam transport system that allows the target to be rotated around the patient. Both rooms contain identical beam collimating systems which consists of interchangeable cones of different field size. A transmission target and filter are used to produce optimal neutron

beam penetration and output. The beam output is 0.5 Gy/min with a beam penetration of 13.2 cm for the 50% depth-dose point. The R.B.E. for cell survival of chinese hampster ovary cells was 3.0. Further physical and biological beam characteristics will be described as well as an overall discussion of the facility.

23258 (EUR—9762-Vol.2, pp 999-1008) **Fast neutron therapy facility at the Pretoria cyclotron.** Hough, J.H.; Binns, P.J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The extraction system of the National Accelerator Centre cyclotron in Pretoria has been modified to deliver deuteron currents in excess of 40 micro A onto a Be target. The generated fast neutron beam is collimated by a variable field size collimator installed in the newly constructed therapy vault. The prescribed patient dose is monitored by twin transmission ionization chambers with the associated dose monitoring system being controlled by a microprocessor. The physical characteristics of the beam were determined in air and in-phantom using a 0.5 cm^3 Exradin TE chamber and a Mullard GM tube (ZP 1300). The total dose yield in air at an SSD of 135 cm is 0.51 cGy min^{-1} with a photon contamination of 1.9%. Various biological assays have been undertaken to evaluate the quality of the beam. The results so far obtained are in agreement with other published data.

23259 (EUR—9762-Vol.2, pp 1009-1017) **Recent development of the neutrontherapy facility at the cyclotron Cyclone in Louvain-la-Neuve.** Richard, F.; Vynckier, S.; Marquebreucq, S.; Robert, P.; Wambersie, A.; Meulders, J.P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Neutrontherapy was started, in March 1978, at the cyclotron of the Universite Catholique de Louvain, in Louvain-la-Neuve. Neutron beams generated by 50 MeV deuterons on beryllium were used up to 1981; since 1982, neutrons are produced by 65 MeV protons on beryllium (with an additional 2 cm polyethylene filter). Irradiations are performed with a fixed vertical beam; the collimation is obtained using a series of interchangeable inserts. A second irradiation room, located at the same level and adjacent to the first one, was built in 1983. It will be equipped with a horizontal neutron beam and interchangeable inserts, and will be operational for p (65) + Be neutrons in 1985. On the other hand, a variable multileaf collimator is now under construction for the vertical neutron beam. A new control desk and monitoring systems have been developped and are now used for routine treatments. In addition to neutrontherapy, proton beam therapy is foreseen with the horizontal beam. Ninety MeV protons can be produced by the cyclotron.

23260 (EUR—9762-Vol.2, pp 1029-1036) **Superconducting cyclotron for neutron radiotherapy.** Maughan, R.L.; Powers, W.E.; Orton, C.G.; Ragan, D.P.; Blosser, H.G.; Blosser, G.F.; Burleigh, R.J.; Jemison, E.B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A superconducting cyclotron purposely-designed for application to neutron radiotherapy is described. The proposed accelerator will produce up to 20 micro A of 50 MeV deuterons incident on an internal beryllium target. Because the superconducting magnet is so much smaller and lighter than a conventional magnet the machine weighs only 20 tons and can be mounted between two large rings and rotated through 360° about the isocenter at an SAD of 183 cm. A neutron dose rate of 0.70 Gy min^{11} is anticipated at the isocenter with 10 micro A of deuteron beam. A depth-dose characteristic similar to 4 MeV X-rays is expected (i.e. 50% depth-dose at 13.5 - 14 cm). Collimation of the neutron beam will be achieved using molded inserts of polyethylene loaded concrete, similar to the system in use at the Fermi Laboratory. It is intended to fabricate custom-made shaped collimator inserts for patient treatments. Neutron therapy facilities based on conventional cyclotrons are both costly and complex. A superconducting cyclotron of the type described here can be built for approximately one-third to one-half the cost of a conventional machine. The superconducting cyclotron is very simple in comparison with most modern isochronous cyclotrons and, hence, should be very reliable.

23261 **(GSI—86-43-Prepr.) Heavy ion synchrotron and cooler ring at GSI.** Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1986. 17p. (CONF-8609159—4-Prepr.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751179.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

During the last years GSI developed plans for future accelerators and experimental facilities with the intention to extend heavy ion research in a wide range to higher energies and into new fields using novel techniques for acceleration, accumulation, storage and phase space density increase of heavy ion beams up to /sup 238/U. Recently the project was approved and funded by the Federal Ministry for Research and Technology. (orig./HSI).

23262 (INIS-mf—10589, pp 112-113) **Isochronous cyclotron of the Nuclear Physics Institute.** Bejsovec, V.; Krivanek, M.; Trejbal, Z. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23263 (INIS-mf—10589, pp 358-359) **Shall we build a synchrotron radiation source in Czechoslovakia?.** Sedlak, J. 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23264 **(LBL-PUB—458) 88-Inch Cyclotron newsletter.** Stokstad, R. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006173.

Activities at the 88-Inch Cyclotron are discussed. Increased beam time demand and operation of the ECR source and cyclotron are reported. Experimental facility improvements are reported, including improvements to the High Energy Resolution Array and to the Recoil Atom Mass Analyzer, a new capture beamline, development of a low background counting facility. Other general improvements are reported that relate to the facility computer network and electronics pool. Approved heavy nuclei research is briefly highlighted. Also listed are the beams accelerated by the cyclotron. (LEW)

23265 **Electron beam accelerator with magnetic pulse compression and accelerator switching.** Birx, D.L.; Reginato, L.L. (to Dept. of Energy, Washington, DC). US Patent 4,646,027. 24 Feb 1987. Filed date 22 Mar 1984. vp.

This patent describes an apparatus capable of acceleration of electrons to energies of at least 1 MeV at currents of at least 100 A over a time interval of at most 1 μsec. and pulse repetition rates of up to 20 kilohertz, the apparatus comprising: an electron beam injector for generating focused beam of electrons of energy substantially ≧0.1 MeV; substantially identical accelerator modules, each module serving to receive the beam of electrons and to increase their kinetic energies by substantially 0.1-1.0 MeV, each module having a module axis that is coaxial with the axis of the electron beam injector, each accelerator module comprising: a toroid of ferromagnetic material, with the axis of the toroid being coaxial with the electron beam injector axis and with the inner diameter of the toroid being sufficient to allow the electron beam produced by the electron beam injector to pass through the hollow center of the toroid along the toroid axis; and a hollow cylindrical electrical con-

ductor, with cylinder axis coaxial with the toroid axis, adjacent to the toroid and making at least one complete turn around the toroid generator, for thereby transporting a voltage pulse about the toroid and abruptly changing the magnetic induction of the toroid ferromagnetic material.

23266 **New MAD: a software tool kit for designing accelerators.** Iselin, F.C.; Keil, E.; Niederer, J. (European Organization for Nuclear Research, Geneva, Switzerland; Brookhaven National Lab., Upton, NY). pp 316-318 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

The Methodical Accelerator Design project (MAD) is a programming tool kit which holds the principal algorithms for designing particle accelerators and simulating the behaviour of the accelerated beam. It includes features of modern program development tools, making it easy to add new algorithms for accelerator physics problems. The goals and the progress of MAD are reviewed. (Auth.).

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 23212, 23278

23267 **(CONF-8611103—8) Bunching in time at the ATLAS [Argonne Tandem-Linac Accelerator System] accelerator.** Pardo, R. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004867.

From 20. symposium of North Eastern Accelerator Personnel; Notre Dame, IN, USA (3 Nov 1986).

The ability to manipulate the energy spread and time width of the beam from the ATLAS linac is an important feature used by the experimental program at Argonne. The time resolution which can be obtained on target has been shown to be less than 150 ps. for all beams through ^{58}Ni. The fundamental ideas which apply to the bunching of heavy ion beams are described and the limitations and capabilities of the bunching system are discussed. A sequential guide for obtaining good timing on target is included.

23268 **(DOE/ER/40216—004) Accelerator research studies: Technical progress report for the period June 1, 1986 to May 31, 1987.** (Maryland Univ., College Park (USA)). 1987. Contract AC05-85ER40216. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006339.

Progress is reported in the study of instabilities and emittance growth in periodic focusing systems for intense beams, collective ion acceleration by intense electron beams and pulse-powered plasma focus, and microwave sources and parameter scaling for high-frequency linacs. Results of a solenoid lens realignment are reported. Theoretical work with particle simulation codes is underway. Laser-controlled collective ion acceleration was demonstrated, a time-resolved Thomson spectrometer was developed, and theoretical studies have led to the development of improved analytical and simulation models describing the equilibrium state and the collective acceleration mechanism in an electron beam with co-moving ions. Progress is reported in the development of a gyroklystron electron gun, and theoretical work on frequency scaling and wakefield effects resulting in codes for quick evaluation of different parameter regimes for electron-positron colliders is discussed. Studies of quadrupole wakefield effects have commenced. (LEW)

23269 **(GSI—86-42-Prepr.) Electron cooling of heavy ion beams.** Liesen, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1986. 33p. (CONF-8607101—1-Prepr.). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751183.

From 18. europhysics conference of the European Group for Atomic Spectroscopy (EGAS-18); Marburg, F.R. Germany (8 Jul 1986).

An introduction to the concept of phase-space compression of heavy-ion beams by electron cooling is given. Emphasis is put on a simple rather than a rigorous theoretical treatment of the underlying ideas. Some practical aspects are discussed in connection with a presentation of the designed cooling device for the ESR project of GSI Darmstadt. The problems of cooling-electron capture are briefly addressed. (HSI).

23270 **(LA-UR—87-297) Scaling laws for aberrations in magnetic quadrupole lens systems.** Moses, R.W.; Heighway, E.A.; Christian, R.S.; Dragt, A.J. (Los Alamos National Lab., NM (USA); Purdue Univ., Lafayette, IN (USA). Dept. of Physics; Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—2). NTIS, PC A02. File Number DE87006074.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A comparison has been made of the third-order (spherical) abberrations in magnetic quadrupole lenses for use in conventional charged particle beam transport systems. An analytical description of the abberrations is presented and this is compared with the results of high order numerical integration. The dependence of the aberration strength on the system geometry and f number is given and a comparison of doublet and triplet systems made. The reduction of the aberrations in both doublet and triplet systems using embedded magnetic octupole lenses is also discussed and analytical predictions are given.

23271 **(LA-UR—87-354) Finding beam focus errors automatically.** Lee, M.J.; Clearwater, S.H.; Kleban, S.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36;AC03-76SF00515. 13p. (CONF-870302—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006049.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An automated method for finding beam focus errors using an optimization program called COMFORT-PLUS. The steps involved in finding the correction factors using COMFORT-PLUS has been used to find the beam focus errors for two damping rings at the SLAC Linear Collider. The program is to be used as an off-line program to analyze actual measured data for any SLC system. A limitation on the application of this procedure is found to be that it depends on the magnitude of the machine errors. Another is that the program is not totally automated since the user must decide a priori where to look for errors. (LEW)

23272 **(LA-UR—87-660) Modification of acceleration element in "TRANSPORT".** Hurd, J.W.; McGill, J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—4). NTIS, PC A02. File Number DE87006063.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

One of the uses at LAMPF of the beam-dynamics code TRANSPORT is to model and tune the proton beams in the side-coupled linac. Significant differences are found between measured beam characteristics and those calculated by an early version of TRANSPORT. These differences are reduced to acceptable limits by modification of the original accelerator transformation matrix used in the code. The modified element and a brief description of its derivation are presented. The modified matrix reduces to the original matrix in the relativistic limit. The modified matrix is also compared to results of numerical integration to obtain some indication of its accuracy.

23273 **(UCID—20971) Space charge limited emission tests of the DPC computer code.** Boyd, J.K. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006600.

The numerical design of accelerator injectors requires a model for the field emission of particles. To test the numerical model used in the DPC code the equation for space charge limited

emission has been derived and solved. Comparisons are made at low and high energy between the semi-analytic space charge limited emission solution and DPC for slab, cylindrical, and spherical geometry.

23274 **Two-dimensional dynamics of the plasma wakefield accelerator.** Keinigs, R.; Jones, M.E. (Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545). *Physics of Fluids;* **30**: No. 1, 252-263(Jan 1987).

A general analysis of the electromagnetic wakefields for an axisymmetric charge distribution moving through a cold uniform plasma is presented. Particular attention is given to the electromagnetic and relativistic effects influencing the waves. It is shown that the plasma provides shielding of the transverse wakefields on a scale length of a few electromagnetic skin depths (c/ω/sub p/). The implications for plasma wakefield accelerators are that driving beams with radii of a few skin depths will experience severe pinching, whereas larger beams will be subject to filamentation instabilities. These conclusions are supported by self-consistent particle-in-cell simulations. The deleterious effects of transverse wakefields will severely limit the accelerating gradients that can be obtained even if a magnetic field is used to guide the driving beam.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 23217, 23268, 23373, 23374, 23377, 23382, 23822, 24285

23275 (EUR—9762-Vol.2, pp 1037-1046) **Beam shaping blocks device for neutron therapy in Orleans.** Sabattier, R.; Breteau, N. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A vertical neutron beam is produced by 34 MeV protons incident on a Beryllium target. Heavy interchangable inserts give square fields from 5 x 5 to 15 x 15 cm at SSD 135 cm. To provide rectangular and irregular fields, a second collimator is placed next to the shield face of insert. This set consists in 20 cm hand-movable steel blocks on a plexiglass plate followed by a sheet of lead. Dose profiles shaped either with the latter set or with heavy insert are very similar. Dose supplement outside the field is low. Arrangements of several blocks on plate according to selection of heavy insert and SSD allow a very large range of rectangular and irregular fields.

23276 (GSI—86-14) **Beam response problem in the RFQ.** Cocher, S.; Mueller, R.W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Paris-1 Univ., 75 (France)). Aug 1986. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751230.

In this report the calculation of the charges and currents influenced by ion beams on the electrodes of a RFQ with a split coaxial resonator structure is described. (HSI).

23277 (INIS-mf—10581, pp 225-227) **New facilities on the 3 MeV Van de Graaff accelerator developed and proposed.** Fallon, J.P.; Boldeman, J.W.; Cohen, D.D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights; Australian Inst. of Nuclear Science and Engineering, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A 3 MeV Van de Graaff accelerator has been in operation at Lucas Heights for 21 years achieving over 77,000 hours operation. With the ageing of the accelerator, there has been a decrease in the amount of fundamental research and an increase in applications work. The present accelerator offers a unique tool to be used in assessing the suitability of components and systems for applications in an environment where electrostatic fields and radiation pose a significant problem. It also lends itself as a suitable injection stage to study post acceleration techniques.

23278 (INIS-mf—10581, pp 111-116) **Beam optics on the Melbourne Proton Microprobe.** Jamieson, D.N.; Colman, R.A.; Allan, G.L.; Legge, G.J.F. (Sydney Univ., Australia. School of Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

This review paper summarises results of ion optics development work conducted on the Melbourne Proton Microprobe and the associated Pelletron accelerator. The properties of a field ionization ion source have been investigated with the aim of replacing the existing RF ion source in the accelerator in order to obtain a brighter beam for the microprobe. The electrostatic emitter lens in the terminal of the accelerator has also been investigated with the aim of improving the focus of the accelerated beam. Finally, the aberrations of the probe forming lens system have been studied and it is shown how some of these may be corrected with an octupole lens.

23279 (Juel—2062) **Characteristics of a high current ion source operated with lithium.** Bay, H.L.; Dullni, E.; Leismann, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). May 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751190.

A low pressure arc ion source has been tested for operation with lithium. Currents up to 120 mA could be extracted through a multiple aperture extraction system at energies of 30 keV. The ion beam was neutralized up to 70% in a charge exchange cell filled with lithium vapour. The beam divergence ranged from 20 to 25 mrad full angle deduced from the spatial distribution of the collision induced Li I resonance line. Current densities from 2 to 3 mA/m/sup 2/ at a distance of 1.9 m from the source were measured either by laser induced fluorescence or with a Faraday cup.

23280 (LA-UR—87-663) **Programmable master-timer system.** Potter, J.M.; Barnes, M.L.; Bjorklund, E.A. (Los Alamos National Lab., NM (USA)). Feb 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—1). NTIS, PC A02. File Number DE87006064.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Clinton P. Anderson Meson Physics Facility (LAMPF) master-timer system provides a 96-channel timing solution of programmable signals and eight predefined system signals required for accelerator operation. Each signal may differ in delay, length, and rate of repetition. Timing solutions are calculated in the LAMPF central control computer, a VAX 11/780, and down-loaded to the master-timer computer, a μVAX-II. The one second timing solution consists of 120 macropulses synchronized to the zero crossing of the ac line. The output signal resolution is one microsecond. This CAMAC-based system is implemented in a dual configuration to ensure versatility and reliability. Each subsystem provides two, 96-channel timing solutions. Any of the four master-timer solutions can be loaded, verified, and then synchronously selected. If the μVAX-II discovers a timing error during self-testing, it automatically switches to a valid solution. Once loaded, the system will continue to run without computer intervention. The master-timer system has the capability of local control and of displaying current status information. Adaptability, reliability, and self-testing assure that the LAMPF master-timer system will keep pace with future requirements.

23281 (LA-UR—87-669) **A CAMAC based knob controller for the LAMPF control system.** Smith, W.; Bjorklund, E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—5). NTIS, PC A02. File Number DE87006065.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The control computer for the Los Alamos Meson Physics Facility (LAMPF) has been recently upgraded from an SEL-840 to

a VAX 11/780 running the VMS operating system. As part of this upgrade, a CAMAC-based knob controller was developed for the new control system. The knobs allow the facility operators to have slew control over software selectable accelerator devices. An alphanumeric display associated with each knob monitors the progress of the selected device. This paper describes the system requirements for the new LAMPF knob controller, and the resulting hardware and software design.

23282 **An enhanced 8086-based CAMAC crate controller.** Dawson, J.W.; Bayer, J.B.; Chan, L.; Ciarlette, D.; Haberichter, W.N.; Stanek, R.W. (High Energy Physics Div., Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 232-235(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

An enhanced CAMAC crate controller (ECC) has been developed for data handling for Fermilab experiment E-704. The module also is currently used in an experiment to make a precise measurement of the weak vector coupling constant. The ECC incorporates hardware to do block transfers (DMA) of CAMAC modules within the crate at several times effective CAMAC rates, or it may e programmed to do individual CAMAC transfers. If desired, data may be rippled out an ECL port to fast ECL devices, or may be written in RAM for processing within the controller itself. The EEC is implemented with the CAMAC Request/Grant protocol for use with an A-2 crate controller, allowing the ECC to be used either as an auxiliary controller or crate controller. Trigger logic in the controller allows the device to respond to any of three triggers by initiating a DMA, or dedicated crates may be daisy-chained, one crate providing a trigger to the next at the conclusion of each DMA. The device is built as much as possible in High Performance CMOS logic using surface mount techniques, on two 8-layer printed circuit cards.

23283 **FASTBUS dual-port memory and display diagnostic module.** Bertolucci, B. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 253-257(Feb 1987). (CONF-861007—). Contract AC03-76SF00515.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A dual-port FASTBUS memory module has been designed as a diagnostic tool for both Crate and Cable Segments.

23284 **Computational needs for modelling accelerator components.** Hanerfeld, H. (Stanford Linear Accelerator Center, Menlo Park, CA). pp 319-321 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

The particle-in-cell code MASK is being used to model several different electron accelerator components. These studies are being used both to design new devices and to understand particle behavior within existing structures. Studies include the injector for the Stanford Linear Collider and the 50 megawatt klystron currently being built at SLAC. MASK is a 2D electromagnetic code which is being used by SLAC both on the IBM 3081 and on the CRAY X-MP at the NMFECC. Experience with running MASK illustrates the need for supercomputers to continue work of the kind described. (Auth.).

4304 Storage Rings

REFER ALSO TO CITATION(S) 23261, 23770

44 INSTRUMENTATION

23285 **(ORNL—6308) Instrumentation and Controls Division progress report for the period July 1, 1984 to July 1, 1986.** Klobe, L.E. (ed.). (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 296p. NTIS, PC A13/MFA01; 1; GPO Dep. File Number DE87006029.

Activities are reported in the areas of measurement and control engineering, reactor instrumentation and control systems, instrumentation for nuclear research and applied health physics, and maintenance management. (LEW)

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 22982, 22987, 23035, 23041, 23197, 23453, 23576, 23576, 23940, 24068, 24070, 24071, 24072, 24073, 24074, 24075, 24081, 24082, 24086, 24091

23286 **(CONF-870158—1) A π0 spectrometer for low-energy heavy-ion reactions.** Young, G.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006211.

From Workshop on proton and neutral meson physics at intermediate energies; Los Alamos, NM, USA (8 Jan 1987).

A spectrometer composes of SF5 and F2 lead-glass blocks has been constructed for detection of neutral pi mesons emitted in low energy heavy-ion reactions. A geometric acceptance of nearly 10% of 4π is possible; the π^0 detection efficiency varies between this value at T/sub π/ $\simeq$ O MeV and 2% for T/sub π/ $\sim$100 MeV. Integrated cross sections as low as 300 pb have been measured. A few comments on the spectra observed are presented. In particular, evidence is seen for pion reabsorption. The total yields are apparently too large to interpret in single nucleon collision or statistical models. 18 refs., 7 figs.

23287 **(CONF-870335—3) Summary and analysis of neutron measurements conducted during the Oak Ridge personnel dosimetry intercomparison studies.** Swaja, R.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS MF A01; 2; GPO Dep. File Number DE87004625.

From International conference on radiation dosimetry and safety; Taipei, China (2 Mar 1987).

Since 1974, neutron personnel dosimetry intercomparison studies (PDIS) have been conducted annually at the Oak Ridge National Laboratory's (ORNL) Dosimetry Applications Research Facility. During these studies, neutron dosimeters are mailed to ORNL, exposed to low-level (less than 15 mSv) dose equivalents in a variety of mixed-radiation fields produced using the Health Physics Research Reactor (HPRR), and then returned to the participants for evaluation. Beginning with the Seventh PDIS in 1981, interest and participation in the Oak Ridge intercomparisons increased significantly and consistent and documented techniques for determining reference neutron dose equivalents for the HPRR were introduced. This document presents a summary and analysis of approximately 3400 neutron dose equivalent measurements made using a variety of personnel dosimeters and reported for PDIS 7-12. 16 refs., 3 tabs.

23288 **(DOE/ER/40175—1) Construction of a high precision vertex detector to be installed in the CLEO experiment at the Cornell Electron Storage Ring: Final report.** (Ohio State Univ. Research Foundation, Columbus (USA)). [1987]. Contract FG02-84ER40175;AC02-76ER01545. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006252.

Two projects were completed. The first was the construction and operation of a state-of-the-art high precision vertex detector and Beryllium beam pipe for the CLEO detector at the Cornell

Electron Storage Ring (CESR). The second project, also for CLEO, was the construction and operation of a vertex detector insert (inner vertex detector) and smaller Beryllium beam pipe. Both projects are summarized.

23289 **(EUR—9762-Vol.1) Proceedings of the 5. Symposium on neutron dosimtery radiation protection aspects.** Schraube, H.; Burger, G.; Booz, J. (Commission of the European Communities, Luxembourg). 1985. 671p. (CONF-8409161—Vol.1). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063.

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Proceedings of the fifth symposium on neutron dosimetry, organized at Neuherberg, 17-21 September 1984, by the Commission of the European communities and the GSF Neuherberg, with the co-sponsorship of the US Department of Energy, Office of Health and Environmental Research. The proceedings deal with research on concepts, instruments and methods in radiological protection for neutrons and mixed neutron-gamma fields, including the generation, collection and evaluation of new dosimetric data, the derivation of relevant radiation protection quantities, and the harmonization of experimental methods and instrumentation by intercomparison programmes. Besides radiation protection monitoring, the proceedings also report on the improvement of neutron beam dosimetry in the fields of radiobiology and radiation therapy.

23290 (EUR—9762-Vol.1, pp 275-284) **Wsub(N) for methane-based TE-gas and carbon dioxide and Wsub(N) and gas-to-wall dose conversion factors for TE/TE cavities.** Makarewicz, M.; Burger, G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The mean energy necessary to form an ion pair, Wsub(n), by the charged particles produced by neutrons has been calculated CO_2 and methane based TE-mixture. Initial charged particle spectra were generated by a computer code of Caswell and Coyne. W-values for charged particles were reevaluated based on published and own experimental data. A broad peak in Wsub(n) for TE-gas was found at energies around 0.4 keV, as a result of competition between the $_{14}N(n,p)$ reaction and elastic scattering of neutrons on hydrogen. The derived Wsub(n)-values are a bit lower than those of Goodman and Coyne (1980), up to about 13 MeV. The difference is usually less than 0.6%, except in the energy region of 0.1-0.2 MeV, where it rises to 1.1%. Wsub(n) for CO_2 increases steeply with decreasing neutron energy. Ionization induced by neutrons of energy less than 20 keV was neglected in this case. Wsub(n) and gas-to-wall absorbed dose conversion factors, r, were calculated for 0.01, 0.1, 1 and 10 cm^3 TE/TE spherical cavities and for an infinitesimal one (Bragg-Gray). Stopping power data were those recommended by ICRU 36. The interesting result is that Wsub(n) and r values for intermediate size cavities may exceed the asymptotic 'limits' as derived for the Bragg-Gray cavity and the infinite one (gas).

23291 (EUR—9762-Vol.1, pp 287-307) **Practical implementation of microdosimetric counters in radiation protection.** Menzel, H.G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A workshop on the Practical Implementation of Microdosimetric Counters in Radiation Protection was held at Homburg (Saar), FRG from 15th to 17th May, 1984, organized jointly by the Commission of the European Communities, the European Radiation Dosimetry Group (EURADOS) and the Universitaet des Saarlandes. This report summarizes results of the workshop based on the presentation of 22 papers and extensive discussions of the more than 50 scientists attending the meeting.

23292 (EUR—9762-Vol.1, pp 309-320) **Dosimetric studies with non-hydrogeneous proportional counters in well defined high energy neutron fields.** Buehler, G.; Menzel, H.G.; Schuhmacher, H.; Guldbakke, S. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Low pressure proportional counters with mono-elemental walls made of graphite, magnesium and aluminium were used to measure ionization yield spectra of monoenergetic neutrons of 15.0 and 17.0 MeV. Neutron fluence and neutron spectral fluence were determined to evaluate kerma-to-fluence ratios (kerma factors) from the proportional counter spectra. The ionization yields due to protons, alpha particles and heavy recoil particles reflect the energy dependence of Q-values and cross sections for nuclear reactions in the elements under investigation. The kerma factors for C, Mg and Al are generally lower than calculated values, for carbon significantly.

23293 (EUR—9762-Vol.1, pp 321-329) **Portable microdosimetry system.** Braby, L.A.; Ratcliffe, C.A.; Metting, N.F. (Institut fuer Strahlenschutz Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Recent developments in microelectronics combined with improved techniques for building proportional counters have made it possible to develop a fully automated portable proportional counter system. A prototype device based on these principles has been developed for NASA as a potential space shuttle experiment. This system includes separate detectors and electronics to measure dose and the fluence of high energy heavy ions. Use of an internal alpha particle source provides reliable energy calibration so that the precision of dose measurements can be checked frequently. The dose monitoring detector simulates a 2 μm diameter sphere. The electronics system includes a low noise charge-sensitive preamplifier housed in the detector base, two analog-to-digital converters with amplifier gains differing by a factor of twenty, a pair of 128 channel memories and a CMOS microcomputer which controls the system and automatically calculates dose and dose equivalent. In order to simplify the calculations, the detector gain is automatically maintained at a preset value by adjusting the anode voltage. Dose equivalent and quality factor are calculated from the accumulated energy deposition distribution using the saturated lineal energy. The response of the system to monoenergetic neutrons was tested using a 2 MV Van de Graaff with deuterium and tritium targets. The agreement between mean quality factor indicated by the instrument and the maximum quality factor in a standard phantom is very good, except at 0.09 MeV where the secondary protons are of such short range that they are misinterpreted as low LET particles.

23294 (EUR—9762-Vol.1, pp 331-335) **Modification of neutron response of a TE ionization chamber for radiological protection purpose.** Pszona, S. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A tissue equivalent ionization chamber is applied in all known methods for measuring dose equivalent in mixed radiation fields. Most of the TE ionization chambers are not fully homogeneous. The deviation of a TE ionization chamber from homogeneity leads to inaccurate neutron dosimetry. It is shown that a controlled inhomogeneity of a TE gas filled cavity in a TE ionization chamber results in suitable modification of the response to neutrons particularly in a set of detectors consisting of a TE ionization chamber and an organic scintillation detector designed to determine dose equivalent index quantities of mixed radiation. The response of a TE chamber having infinite cavity filled with following gas mixtures:

TE methane based composition, $CH_4 + N_2$ -TE only for hydrogen, $CH_4 + N_2 + {}^3He$ -TE only for hydrogen was calculated for neutrons in the energy range from thermal to 1 MeV.

23295 (EUR—9762-Vol.1, pp 337-348) **Development and use of a tissue equivalent proportional counter analysis system to measure the dose delivered to the gut of an anthropomorphic phantom from a fission source.** Cousins, T.; Rushton, L.P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

An electronic system has been developed which allows simultaneous pulse height data acquisition for a dynamic range of four orders of magnitude. The system was used to examine lineal energy spectra from a tissue-equivalent proportional counter exposed to monoenergetic neutrons and gamma rays, as well as mixed radiation fields. These spectra were quantified in terms of the microdosimetric parameters and in order to compare with the work of other experimenters, and the predictions of the computer codes NESLES. The results here served to enable development of an automated method of separating neutron and gamma ray dose components in a mixed field. The detector was then placed in a midabdominal position in a realisitic anthropomorphic phantom, which was positioned at both 10m and 170m from a bare, unmoderated critical assembly. Free-field measurements were also conducted at these two distances. Hence neutron and gamma ray doses, and dose transmission factors to the gut were obtained as a function of phantom orientation with respect to a fission source.

23296 (EUR—9762-Vol.1, pp 349-358) **Microdosimetric experiments at a light and heavy water moderated Cf-fission neutron sources.** Jakes, J.; Schraube, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The moderated 252 Cf-fission neutron source recently became an important tool for calibration purposes in radiation protection. The radiation field of this source has been studied by the use of two microdosimetric helix-type proportional counters, i.e. a half and a two inch counter. The lineal energy distributions were determined with both counters in the mixed neutron and gamma fields of the bare Cf-source and the source moderated by 10cm and 15cm light water and 15cm heavy water, respectively. The measurements were done free-in-air and also with a water phantom positioned close to the counters. The ratio of the gamma dose to the neutron dose in ICRU tissue varies between 0.42 for the bare source to 2.8 for the Cd-shielded 15cm h_20 moderated source.

23297 (EUR—9762-Vol.1, pp 359-368) **Personnel monitors utilizing tissue equivalent proportional counters.** Brackenbush, L.W.; Endres, G.W.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The US Department of Energy has established a program to improve neutron dosimetry at facilities where a significant number of workers are exposed to fast neutrons from handling isotopic neutron sources. One facet of this program is the development of small, lightweight personnel monitors to determine dose equivalent as the workers are exposed. These instruments use small cylindrical tissue equivalent proportional counters to detect neutrons, and a microprocessor to determine absorbed dose and dose equivalent. A Pocket REM Meter containing three cylindrical tissue equivalent proportional counters 1.9-cm in diameter and 13-cm long is developed. The instrument utilizes hybrid circuitry and a 256 channel analog to digital converter to supply signals to a CMOS microprocessor, which calculates absorbed dose and dose equivalent for neutrons and displays the results on a liquid crystal display. Independent measurements at the Pacific Northwest Laboratory verified that the Pocket REM Meter is accurate within 20% for determining neutron dose equivalent when exposed to unmoderated or slightly moderated Cf-252 sources, which have been calibrated by the US National Bureau of Standards. The Laboratory is developing a Total Dose Meter to measure absorbed dose and determine dose equivalent from mixed radiation fields of neutrons and gamma rays. Using a single tissue equivalent proportional counter with two amplifiers operated at different gains. Using empirical algorithms derived from exposures to monoenergetic neutrons, it is possible to determine quality factors within about 7% for neutrons with energies between 200 KeV and 7.5 MeV.

23298 (EUR—9762-Vol.1, pp 369-376) **Development of hydrogen proportional counter spectrometry for radiological protection.** Birch, R.; Peaple, L.H.J.; Delafield, H.J.; Marshall, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A transportable neutron spectrometry system, based on spherical hydrogen proportional counters (type SP2), has been developed to measure standard reference radiation fields (for research and development on new dosimeters) and the spectra around nuclear facilities. The system, comprising four counters filled to different pressures, has been calibrated using monoenergetic neutron beams of known energies and the response functions determined. The recorded proton-recoil distribution must be unfolded to give the neutron spectrum. Improvements to the widely used unfolding code SPEC4 are reported. In addition, an iterative unfolding technique has been developed which allows corrections to be made for the effect of counter resolution, and is thus particularly useful for line spectra. Measurements of the neutron leakage spectrum on the top-plate of the 25 MW DIDO reactor at Harwell are presented. The spectrum, which is nearly all below 700 keV, has considerable structure with the peaks corresponding to windows in the cross-section of iron. A transmission spectrum through a beam filter consisting of 200 mm Fe + 200 mm Al + 100 mm S, which is being considered for tumour therapy, is also presented.

23299 (EUR—9762-Vol.1, pp 377-383) **Rem-meter based on tissue equivalent proportional counter.** Nguyen, V.D.; Ricourt, A.; Parmentier, N.; Prigent, R.; Petel, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A dose equivalent meter employing microdosimetric techniques for radiation protection is described. The main advantage of such techniques is illustrated with the evaluation of average dose quality factors for mono-energetic neutron beams. Neutron and gamma dose fractions can be evaluated with this device by a single operation without any other instruments. The problem of separating overlapping spectra is discussed and an attempt to define the variable separation limit proposed.

23300 (EUR—9762-Vol.1, pp 387-401) **Light rem-counter of advanced technology.** Mourges, M.; Carossi, J.C.; Portal, G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Dineutron is a portable radioprotection measurement apparatus for neutron dosimetry. It is based on a new measurement concept developed from the analysis of neutron fields characteristic of industrial facilities and is both lighter and more sensitive than currently used rem-meters. Its sensor is very much smaller then those of commonly encountered remmeters: furthermore an original auto calibration device and a computer enable not only dose equivalent to be measured but also absorbed dose and subsequently the quality

factor characterizing the source measured. Both currently used systems of units can be displayed alphanumerically either as dose rates or as cumulated doses. Measurement times and accuracy are given. The apparatus has been programmed to have an energy independent response to monochromatic neutron radiations in the thermal to 14 MeV range and to wide spectra sources. An example of a measurement range that can be covered is 1m $rem.h^{-1}$ to 20 $rem.h^{-1}$. The apparatus weighs 3 Kg which represents a considerable reduction in comparison with currently marketed equipment.

23301 (EUR—9762-Vol.1, pp 403-414) **Measurement of neutron field quantities using the single sphere albedo technique.** Piesch, E.; Burgkhardt, B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The single sphere albedo technique for analysing stray neutron fields makes use of at least 3 detectors, one in the center of a 30 cm polyethylene sphere and two in positions of an albedo dosemeter at the sphere surface. Linear superpositions of the 3 detector readings allow one to estimate the neutron fluence, absorbed dose, dose equivalent and the quality factor practically independent of neutron energy. The paper describes the recently developed and standardized technique which can be adopted also for the estimation of other dose quantities, namely H_{10} and Hsub(E) as well as for active neutron detectors, generally. Examples of calculated and measured field data for different source and reactor neutron spectra are presented which show that actual field data can be estimated with an energy and angular response of about + or -25%.

23302 (EUR—9762-Vol.1, pp 415-425) **Least squares unfolding and error analysis of Bonner sphere neutron measurements: application to PWR and Little Boy critical assembly measurements.** Hajnal, F.; Griffith, R.V. (Institut fuer Strahlenschutz Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A nonlinear least squares unfolding computer code was developed to analyse Bonner sphere neutron measurements. The code has two parts: Part I - iterative adjustment of trial solutions, and Part II - least squares error analysis. The error analysis is based on a generalized least squares method where the errors in the input data, in the response functions and in the initial trial spectrum are joint probability density functions in the form of covariance matrices. The solution is the differential neutron flux and its covariance matrix, which are functions of the input data, and it reflects all of the information in the input data including the uncertainties. An error estimation of the dosimetric quantities is also possible. The unfolding and data analysis procedure described here are easily applicable to other types of detectors and unfolding problems. The construction of the covariance matrices, the unfolding and the error analysis are discussed briefly, and are illustrated with two examples: spectral and dose measurements in the containment of a PWR, and spectral measurements around the replica of the Hiroshima bomb Little Boy.

23303 (EUR—9762-Vol.1, pp 427-436) **Directional neutron monitor for leak tracing in low energy accelerator installations.** Ettinger, K.V.; Miola, U.J.; Ghosh, A.; Dodd, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung mbH, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Tracing fast neutron leaks from imperfections in the shielding systems of small accelerators requires a light and portable device, which should be able to pinpoint the source of neutrons as well as give some indication of the energy spectrum of leakage. The design of the directional leak monitor is based on the two scintillator neutron spectrometer principle. The first scintillator scatters the neutrons, and those scattered by a selected angle, e.g. 45°, are intercepted by secondary scintillators. The energy of scattered neutron is measured by means of time-of-flight method. The energy lost in the first scattering, energy of scattered neutron and the angle of scattering (which is defined by the geometrical arrangement of the scintillators), are sufficient to reconstruct the original direction of arrival and the initial energy of the neutron. Tests on a model of the leak monitor, consisting of a primary scatterer and two detectors of scattered neutrons, all made of Pilot U scintillating plastic, confirmed the principle of design. The directional characteristics of the monitor corresponds to the half-value angle of about 20°. It was measured in scattering experiments with 14 MeV neutrons.

23304 (EUR—9762-Vol.1, pp 459-466) **Passive neutron dose equivalent meter for environmental and area monitoring in the low dose range.** Jasiak, J.; Burgkhardt, B.; Piesch, E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

For the purpose of long-term monitoring of the natural neutron radiation background in the dose range above 1 μSv the passive neutron dose equivalent meter makes use of track etch detectors and TLDs in the center of a 30 cm polyethylene sphere. Makrofol polycarbonate foil in contact with two (n,α) radiators as well as $^6LiF/^7LiF$ serve as thermal neutron detectors. The track detector is etched electrochemically and the track density is counted in a single field of 0.6 cm^2 using a microfiche reader/printer. The design and holder of the neutron detectors as well as the evaluation technique for both detector types have been standardized. The total dose range has been found to be 5 μSv to 10 mSv for track etch detectors with two (n,α) radiators of different sensitivity and 0.1 mSv to 10 Sv for TLD detectors. Electrochemically etched Makrofol shows practically no fading. The passive neutron dose equivalent meter has been applied for long-term neutron monitoring in the environment of nuclear facilities allowing to estimate the natural neutron radiation background with a random error of 20% after monitoring periods of half a year.

23305 (EUR—9762-Vol.1, pp 469-477) **Protons and neutrons registration by chemically and electrochemically etched CR-39 detectors.** Tommasino, L.; Zapparoli, G.; Djeffal, S.; Cross, W.G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The response of CR-39 detectors to beams of protons and neutrons at different energies has been analysed using respectively chemical etching, electrochemical etching (ECE) and the combination of chemical plus electro chemical etching. For monoenergetic protons, once an appropriate etching is used, the track counting of chemically etched detectors is very simple. The tracks of monoenergetic protons with the same incident angle present uniform shapes and can be easily distinguished from background tracks or defects. Unfortunately, it is difficult to find a single etching process suitable for all the types of proton tracks. Since prolonged chemical etching is required in order to develop high-energy proton tracks, the same etching would cause over-etching of low-energy proton tracks, which may disappear from view, specially if they have energies less than about 500 keV. When adding electrochemical etching to previously etched detectors, these limitations become even more pronounced, since these ECE processes are only capable of enlarging pointed-shape tracks. Finally, the best results have been obtained using electrochemical etching at 60°C with no pre-etching in such a way that the track formation occurs during the ECE processes. For neutron irradiated samples, the track counting after chemical etching is much more complex, because, for a given etching, tracks are formed with different shapes and orientations and will also be at various stages of etching. Once again the best solution appears to be the electrochemical etching with no pre-etching. It is under these etching conditions that CR-39 detectors appear very promising for neutron dosimetry, because their response is both sensitive

and independant of neutron energy over a very wide range (from a few tens of keV up to 15 MeV) and because of the simplicity of track counting and automation.

23306 (EUR—9762-Vol.1, pp 479-489) **CR39 neutron spectrometer with application in 10 μSv dosimetry.** Fews, A.P.; Portwood, T.; Henshaw, D.L.; Turner, T.W.; Worley, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen- und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A passive neutron spectrometer and dosemeter has been designed based on the nuclear track detector CR-39. The device operates principally as a proton recoil detector, the recoil particle originating either in an adjacent radiator or the CR-39 itself. In the spectrometer, the response measured as the conversion efficiency of neutrons to recoil protons recorded in the detector is considered. The phenomenon of tracks originating in the bulk etch layer is treated. As an example of the analysis, a 1 MeV neutron source incident at 45^0 is deconvolved from the measurements on 4600 recoil proton tracks using automated image and track analysis programs. The final stage of the analysis employs a maximum entropy routine to obtain the best fit to the data. A dosemeter has been designed which, has a dose equivalent response in the energy range 100 keV - 15 MeV. It has been established that the sensitivity at different neutron angles will remain different unless a plastic with a substantially higher proton sensitivity is produced. High sensitivity for neutron dose is achieved by the unambiguous detection of recoil particles down to 1 track cm^{-2}. At normal incidence the sensitivity is better than 10 μSv throughout the energy range. For isotropic neutrons the sensitivity is reduced by a factor of 4. Dose equivalency is necessarily achieved at the expense of sensitivity. In the current device dose equivalency is achieved by applying appropriate cut-offs in the automated image analysis software. The energy range of the spectrometer and dosemeter may be extended to include thermal and near thermal energies by the use of ^{10}B or ^{7}Li (n,α) converters in conjunction with cadmium.

23307 (EUR—9762-Vol.1, pp 491-499) **Fully automated analysis of proton etched tracks in CR-39 plastic application in neutron spectroscopy and 10 μSv dosimetry.** Fews, A.P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

An image analysis system has been developed which is capable of fully automated scanning, identification and measurement of etched nuclear particle tracks in plastic. It is here applied to alpha-particle and proton tracks in CR-39 plastic. Reliable and efficient selection criteria reject all non track defects appearing on or in the plastic. The measurable parameters of the etch pits may be measured with a precision approaching or exceeding that of a skilled human observer. This enables the energy of the nuclear track in the plastic to be determined with high resolution, close to the straggling limit. The scanning algorithm developed takes full account of events on the edge of image frames such that all events are analysed once and only once. The ability to identify unambiguously particle tracks against a background of etch defects allows the system to be used for counting low fluxes of particle tracks of the order of one track per cm^2. The system is particularly suitable for neutron spectrometry and 10 μSv neutron dosimetry using CR-39.

23308 (EUR—9762-Vol.1, pp 501-510) **Electrochemical etching and angular dependence of CR-39 neutron detectors.** Pitt, E.; Scharmann, A.; Werner, B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The solid state nuclear track detection material CR-39 shows an angular dependence in the registration efficiency of fast neutrons. This dependance was studied by using thin CR-39 foils that had been bent to a semicircle during irradiation. Irradiations have been carried out at an Am-Be-n-source and with monoenergetic neutrons of 144 keV. The influence of converters and pre-etching prior to electrochemical etching has been investigated. A model is suggested to explain the results.

23309 (EUR—9762-Vol.1, pp 511-518) **Energy angle dependence of response of the NRPB CR-39 fast neutron dosemeter.** Bartlett, D.T.; Steele, J.D. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The National Radiological Protection Board (NRPB) has developed a fast neutron personal dosemeter which employs a CR-39 detector. The detector consists of a flat piece of CR-39 plastic, approximately 25 mm x 40 mm and of thickness 600 μm. Before issue detectors are hermetically sealed inside polyethylene/aluminium laminate pouches. The pouch fits inside a simple polypropylene holder. Proton tracks in the CR-39 detector are revealed by a combination of chemical etching and electrochemical etching. A set of etching parameters has been arrived at which gives adequate sensitivity and energy dependence of response, at acceptable levels of, and variation in, background pit density. The minimum detectable dose equivalent, taken as 2 σ on background, varies between CR-39 batches but is generally about 2.10^{-4} Sv.

23310 (EUR—9762-Vol.1, pp 519-529) **Neutron dosimetry system based on the chemical etch of CR-39.** Harvey, J.R.; Weeks, A.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The potential advantages of a neutron dosimetry system based on the chemical etch of CR-39 are identified. An optical system is described which can be used to give a rapid assessment of etch pit density. The relationship between etch pit density and dose equivalent has been assessed for a range of neutron energies and angles of incidence. The results imply that the technique could be used to give an individual monitoring system with characteristics superior to those presently in use.

23311 (EUR—9762-Vol.1, pp 531-539) **Comparison of fast neutron personnel dosimeters around an electron accelerator.** Esposito, A.; Pelliccioni, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The use of neutron films type NTA as personnel dosimeters in the mixed radiation fields around electron accelerators is completely unsatisfying. In fact a large fraction of the neutron spectrum is in this case under the detection threshold of these instruments. Nevertheless nuclear emulsions are still the most popular personnel neutron dosimeters. Recently, other kinds of dosimeters have been developed. The most promising appears to be the CR-39 plastic, or a combination of a CR-39 plastic and an albedo dosimeter. At LNF, the response of the NTA films around a 350 MeV linear accelerator was compared with the response of two commercial dosimeters of the above mentioned type. The preliminary results of the comparison have emphasized the interesting qualities of the track detectors, i.e. an essentially zero fading and a zero sensitivity to gamma radiation. In addition, the albedo CR-39 combination dosimeters seem to improve significantly the range of neutron energies measured.

23312 (EUR—9762-Vol.1, pp 541-546) **Code for fast neutron dosimetry.** Ott, C.; Jung, M.; Heilmann, C.; Francois, H.; Kappler, A.; Oppel, R.; Demoulin, R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Fast neutron dosimetry is possible via recoil protons coming from (n,p) scattering which are registered in track detectors. We are concerned here with the simulation of the energy lost by such protons, in order to obtain the response of several types of dosimeters in the range from 500 keV to several MeV. To do this we use the albedo neutrons associated with fast incident neutrons. This work was done for the purpose of developing a global method of dosimeter reading based on the silver left along the processed tracks.

23313 (EUR—9762-Vol.1, pp 547-550) **DOE personnel neutron dosimeter evaluation and upgrade program: Informational statement on DOE activities.** Faust, L.G.; Vallario E.J.; Hadlock, D.E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The US Department of Energy initiated a research program in FY-81 to evaluate and upgrade neutron dosimetry at DOE facilities. The program involves DOE national laboratories, universities, and private companies. The objectives of the program are to assess current personnel neutron dosimeter capabilities and to develop improved personnel neutron measurement systems. Two types of passive personnel neutron dosimeters have been used at DOE facilites: NTA film and TLD-albedo dosimeters. Each type exhibits an energy-dependent response to neutron exposure. The NTA film dosimeter only responds to neutrons with energies above 400 KeV. In contrast, the TLD-albedo dosimeter responds to all neutron energies, but the response is inversely proportional to neutron energy. As a consequence the dose equivalent per unit of thermoluminescent response can vary by more than one order of magnitude which then requires some knowledge of the neutron energy spectrum to properly interpret dosimeter results. Two new neutron dosimeters are being developed to overcome these problems: combination/track-etch dosimeters and pocket rem-meters. Track-etch methods have been studied for about 20 years. One of the first track-etch neutron dosimeters was developed in 1964. It was used to detect fission fragment damage in plastic. This dosimeter was not widely applied because the dosimeter material itself contained interfering fissionable radioactivity.

23314 (EUR—9762-Vol.1, pp 583-593) **Multisphere measurements at a heavy water moderated Cf-252 fission source.** Schraube, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The 7 sphere Bonner spectrometer with LiI thermal neutron detector is used to study the slowing down neutron field of the 15 cm heavy water moderated Cf-fission neutron source, and to compare the results with those of the light water moderated field. In order to eliminate geometry effects of the extended source and detector assemblies, and to estimate the scatter contribution, the distance law is measured under low scattering conditions in a separation distance range of 1m to 4m. The scatter contribution at the place of the detector is in the same order of magnitude as that of the unmoderated and the light water moderated Cf-fission source. It amounts to about 3% at 1m distance for the 12 inches detector, if the backscatter contribution is assumed to be constant. The neutron fluence is reduced to 92%, the (maximum) dose equivalent to 21% by the heavy water moderator compared with the unmoderated situation at distances far from the source. Theoretical count rates of the spheres are calculated from available spectral data and compared with the measured ones. In order to eliminate the photon background from the measured pulse height spectra delivered by the LiI detector, a stripping method is used, applying measured pulse height spectra for the neutron and the photon contribution, respectively. Finally, albedo dosemeter were irradiated and their reading compared with the simulated readings as derived from the Bonner sphere measurements.

23315 **(EUR—9762-Vol.2) Proceedings of the 5. symposium on neutron dosimetry beam dosimetry.** Schraube, H.; Burger, G.; Booz, J. (Commission of the European Communities, Luxembourg). 1985. 625p. (CONF-8409161—Vol.2). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120.

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Proceedings of the fifth symposium on neutron dosimetry, organized at Neuherberg, 17-21 September 1984, by the Commission of the European Communities and the GSF Neuherberg, with the co-sponsorship of the US Department of Energy, Office of Health and Environmental Research. The proceedings deal with research on concepts, instruments and methods in radiological protection for neutrons and mixed neutron-gamma fields, including the generation, collection and evaluation of new dosimetric data, the derivation of relevant radiation protection quantitites, and the harmonization of experimental methods and instrumentation by intercomparison programmes. Besides radiation protection monitoring, the proceedings also report on the improvement of neutron beam dosimetry in the fields of radiobiology and radiation therapy.

23316 (EUR—9762-Vol.2, pp 675-686) **Digital approach to neutron dosimetry and microdosimetry.** Turner, J.E.; Hamm, R.N.; Hurst, G.S.; Wright H.A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Work has begun in an effort to develop a new, digital approach to neutron dosimetry. In contrast to analogue methods in current use, digital information describes the track of a recoil charged particle produced by a neutron in a gas in terms of the numbers of ions that occur in given volume elements of a detector. It appears that a device based on the time-projection chamber used in particle physics would enable one to measure relevant data for neutron dosimetry. Such an instrument would also furnish data sought in microdosimetry. In this paper we will describe the digital approach to dosimetry and will report on the initial Monte Carlo calculations of the detailed transport of protons and electrons in Ar, CH_4, and P-10 gases. These calculations are being used to assess the feasibility of constructing a practical chamber for use in neutron dosimetry and in microdosimetry.

23317 (EUR—9762-Vol.2, pp 687-694) **Future of A-150 TE plastic.** Goodman, L.J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

For the past 26 years a large number of laboratories have constructed or purchased ionization chambers, proportional counters, and phantoms made of A-150 tissue-equivalent plastic, and they have amassed a considerable amount of data and experience in its properties and uses. The United States National Bureau of Standards is now considering the desirability of supplying A-150 plastic as a research material with a certified homogeneity. We are, however, faced with a problem since the nylon used in A-150 has been discontinued by the manufacturer and the current stock of A-150 has been estimated to be adequate to supply the demand for only the next 2 or 3 years. Thus, it will be necessary to reformulate the plastic mixture we will be using in the future. This situation offers us the opportunity to change the composition of tissue-equivalent plastic to better conform to present-day requirements. To elucidate just what these requirements are, we have conducted a postal survey of the opinions of neutron dosimetrists and the results

are presented and discussed. It is concluded that the present A-150 plastic and a future tissue-equivalent plastic formulation should be made research materials, and that a future tissue-equivalent plastic should be made to conform as closely as possible to the soft tissue composition given in ICRU Report 33.

23318 (EUR—9762-Vol.2, pp 695-704) **Comparison of two ionisation chambers for neutron dosimetry.** Williams, J.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen- und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Problems associated with the use of A-150 plastic as a tissue-equivalent material for the construction of ionisation chambers for neutron dosimetry are discussed. An alternative material (designated N-3) which is made from a mixture of polyethylene and graphite is described. This material has equal atomic proportions of hydrogen and carbon and is therefore styrene equivalent. Ionisation chambers constructed of N3 and A-150 plastic are described. Measurements were made both in air and in phantom in a d(15) + Be neutron beam using these chambers. The results from the N3 ionisation chamber are compared with those from the A-150 chamber of the same design as well as with those from two Exradin type T-2 chambers. The overall spread of results from the A-150 chambers is 2%. The N3 chamber results agree with those from the A-150 chamber to within 1%. These results are discussed with respect to the overall uncertainty in ionisation chamber dosimetry.

23319 (EUR—9762-Vol.2, pp 705-715) **Characteristics of high-pressure ionization chambers with several filling gases in neutron and photon fields.** Zoetelief, J.; Engels, A.C.; Bouts, C.J.; Broerse, J.J.; Hennen, L.A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The characteristics of ionization chambers as a function of the pressure of various filling gases are of practical as well as theoretical interest. The first aspect concerns applications in radiation protection and radiobiology; the second is connected with basic subjects such as ion recombination and cavity theory. The operation of ionization chambers at elevated gas pressures will increase their sensitivity and can provide information on radiation quality. From measurements with tissue equivalent (TE) and Al high-pressure ionization chambers performed at gas pressures of up to 8 MPa for ^{137}CS gamma-rays and neutrons, it is concluded that the amount of initial recombination increases with increasing radiation quality and that the relative reading can be increased. Argon appears to be the most suitable gas among the investigated ones to obtain a sensitive TE ionization chamber for ^{137}Cs gamma-rays and 14.5 MeV neutrons. For 0.9 MeV neutrons, the use of CH_4 provides the most sensitive ionization chamber. Large differences are found between ^{137}Cs gamma-rays and 0.9 MeV neutrons with regard to pressure dependence of the reading with various filling gases, ion recombination and chamber wall material. The most interesting gases to investigate cavity size effects are Ar and CH_4. In the 0.9 MeV neutron beam, the photon absorbed dose component can be derived from the pressure dependence of the reading using Ar.

23320 (EUR—9762-Vol.2, pp 717-725) **Determination of dose components in mixed gamma neutron fields by use of high pressure ionization chambers.** Golnik, N.; Pliszczynski, T.; Wysocka, A.; Zielczynski, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The two ionization chamber method for determination of dose components in mixed γ-neutron field has been improved by increasing gas pressure in the chambers up to some milions pascals. Advantages of high pressure gas filling are the followings: 1) significant reduction of the ratio of neutron-to gamma sensitivity for the hydrogen-free chamber, 2) possibility of sensitivity correction for both chambers by application of appropriate voltage, 3) high sensitivity for small detectors. High-pressure, pen-like ionization chambers have been examined in fields of different neutron sources: a TE-chamber, filled with 0.2 MPa of quasi-TE-gas and a conductive PTFE chamber, filled with 3.1 MPa of CO_2. The ratio of neutron-to-gamma sensitivity for the PTFE chamber, operated at electrical field strength below 100 V/cm, has not exceeded 0.01 for neutrons with energy below 8 MeV. Formula is presented for calculation of this ratio for any high-pressure, CO_2-filled ionization chamber. Contribution of gamma component to total tissue dose in the field of typical neutron sources has been found to be 3 to 70%.

23321 (EUR—9762-Vol.2, pp 727-738) **Neutron dose measurements across an Al - A-150 interface using extrapolation chambers.** Montelius, A.; Brahme, A.; Nordell, B. (Institut fuer Strahlenschutz, Gesellschaft fuer Stralen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The dose distributions from 8.0 MeV, 14.7 MeV and p(50)+Be neutrons in the vicinity of an interface between Al and tissue equivalent plastic (A-150) was investigated with two extrapolation chambers. In one chamber both the front electrode and the collector with guard ring are exchangeable, while the other chamber has fixed collector and guard in A-150 and exchangeable front electrode. The distance between the electrodes in the two chambers is variable with a micrometer screw up to 15 mm and 24 mm respectively. The charge collecting volume was determined with a precision better than 0.5% by measuring the chamber capacitance. The ionization on the tissue equivalent side of the interface was measured by extrapolation in methane based tissue equivalent gas. On the Al side of the interface the ionization was measured in Ar, which is fairly well matched to Al. The mean ionization versus electrode separation was corrected for beam divergence. By differentiating the curves of mean ionization versus electrode separation and dividing by mass of the gas, the mass ionization as a function of distance from the interface was obtained. The maximum electrode separation corresponds to a distance of about 2 mg cm^{-2} from the interface. The conversion of mass ionization into absorbed dose was carried out assuming an energy independent W-value for each gas. The shape of the dose distributions across the interface clearly demonstrates the transport of charged particles.

23322 (EUR—9762-Vol.2, pp 739-748) **Neutron response of ion chamber photon dosemeters for neutron energies between 144 keV and 15.5 MeV.** Gulbakke, S.; Jahr, R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The neutron response relative to the photon response of eight penholder dosemeters and three dose rate meters has been investigated at neutron energies of 0.144, 0.57, 5.0 and 15.5 MeV. All these instruments are commercially available and have been typetested by the Physikalisch-Technische Bundesanstalt. The monoenergetic neutrons were produced by bombarding various targets with protons and deuterons from a Van de Graaff accelerator. The neutron energy dependence of the ratio of the dose equivalent response for neutrons relative to that for photons is very similar for all instruments. It shows an increase with increasing neutron energies from about 0.7% at 0.144 MeV to 12% at 15.5 MeV for penholder dosemeters and from about 0.5% at 0.144 MeV up to about 14% at 15.5 MeV for dose rate meters. In addition, the penholder dosemeters were irradiated on the front side of a cylindrical water phantom. The influence of the phantom decreases with increasing neutron energies.

23323 (EUR—9762-Vol.2, pp 749-758) **Ksub(u)-values of a ZP1300 Geiger-Mueller counter between 0.7 and 7.5 MeV.** Jones, D.T.L.; McMurray, W.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The pulsed beam time-of-flight method has been used to determine the ksub(u)-values of an energy compensated type ZP1300/PTFE Geiger-Mueller counter in the 0.5 to 7.5 MeV region. Monoenergetic neutrons from the T(p,n)^{3}He and D(d,n)^{3}He reactions were used in the measurements. The neutron flux was determined by simultaneous measurement of the time-of-flight spectra with a NE213 scintillation counter of known efficiency. The ksub(u)-values obtained are in good agreement with previous data in this energy region using similar counters. All published values obtained with ZP1300/PTFE counters have been fitted with a function of the form ksub(u)(Esub(n)) = a Esub(n)sup(b) where a = 0.25 +- 0.01 and b = 0.78 +- 0.03.

23324 (EUR—9762-Vol.2, pp 761-781) **Relative sensitivity of thermoluminescent material to neutrons: a review of available data.** Gibson, J.A.B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The review is intended as the basis for establishing the response of thermoluminescent (TL) materials to neutrons so that these materials can be used in the assessment of the gamma-ray dose in mixed neutron and gamma-ray fields. The relative tissue-kerma sensitivity, k, is defined as the ratio of the measured response of the TL material to neutrons to the measured response to ^{60}Co gamma radiation relative to the tissue kerma for neutrons and gamma radiation, respectively. There are many factors which effect k including the TL material itself (its composition, dimensions and surrounding material), the characteristics of the TL reader, the irradiation conditions, batch to batch variations and environmental conditions such as temperature, humidity, UV light and irradiation history. None of the data in the literature is produced under standard conditions and so a true comparison is not possible. However, it has been possible to eliminate the kerma dependent factors from k and so demonstrate that the efficiency of TL materials for detecting neutrons, etasub(n), relative to that for detecting ^{60}Co gamma rays, etasub(s), is essentially constant for a given material for neutron energies from thermal to about 10 MeV. Above this energy, etasub(n)/etasub(s) increases significantly. The increase can be accounted for qualitatively by a reduction in LET at higher energies. There are large uncertainties in the data which could be reduced if standard conditions could be agreed internationally. However, following this Symposium, a full report of this study will be published by CENDOS with any more information that may be forthcoming.

23325 (EUR—9762-Vol.2, pp 783-794) **Spectral dependence of response coefficients and applicability of the two-peak TLD method in mixed neutron-photon radiation fields.** Rassow, J.; Duehr, R.; Broerse, J.J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforshung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The difference in LET dependence of two main glow peaks of CaF_2:Tm (TLD-300) is demonstrated to be useful for the measurement of fast neutron and gamma ray absorbed doses of clinical interest. This can be achieved by a method of careful glow curve analysis ("Two-peak TLD method"). The dependence of TL response of the two peaks of TLD-300 on the neutron and gamma ray energies has been studied. The method is found to work satisfactorily for d(2.3)+D and d(14)+Be neutron beams. The neutron response coefficients of 150°C and 140°C peaks are about 50 and 10 times the gamma ray response coefficients, respectively, and this restricts the applicability of the dosimetric method for the sites where Dsub(G)Dsub(T) is large. However, the gamma-ray component of the neutron beam is mainly high-energetic (2.2 MeV), produced by the ^{1}H(n,γ)^{2}D reaction in the phantom. There had been dosimetric problems with d(0.5)+T and p(65)+Be neutron beams which necessitates to look into the probable effects causing the inaccuracy in the absorbed dose measurement. As the best suited annealing condition for TLD-300 was found to be 400°C for 1 h. A following 100°C for 1 h can be omitted.

23326 (EUR—9762-Vol.2, pp 795-804) **Application of a personal computer for analysis and data reduction of TLD-300 glow curves for dosimetry in mixed neutron and photons fields.** Meissner, P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

TLD-300 material can be used to measure simultaneously neutron and photon absorbed dose with one small detector. It is applied for clinical dosimetry for d(14)+Be neutrons to measure whole dose distributions of complex treatment technique. In this application many glow curves are measured and should be stored for documentation. Therefore it is desirable to reduce the number of data which must be stored for one glow curve. The TLD-300 glow curves can be approximated by a sum of 8 Gauss functions, so that the whole glow curve can be reconstructed from 24 numerical values. Moreover by a appropriate fitting procedure it is found that the positions and widths of the Gauss functions needed are almost the same for all detectors. They seem to be independent of dose and beam quality. Only the parameters of the two Gauss functions at the lowest heating temperature, amplitude and even position and width, depend on time elapsed between irradiation and read-out of the detector.

23327 (EUR—9762-Vol.2, pp 805-815) **Response of CaF_2:TM (TLD-300) to monoenergetic fast neutrons.** Schraube, H.; Weitzenegger, E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Thulium doped Calcium Fluoride (TLD-300) had been proposed in the literature for the application as combined neutron/photon detector at neutron therapy beams. In this paper this thermoluminescent material is investigated with respect to its response to fast neutrons and its ability to separate neutron and photon contribution by analyzing the glow curves. TLD-300 probes are irradiated to monoenergetic neutrons in the energy range 0.6 MeV and 15 MeV. The thermoluminescence reader is used in a way that glow curves and temperature curves versus readout time are stored simultaneously in a computer. The resulting light functions versus temperature are analyzed in two different ways, i.e. applying a non-linear multiparameter fit and a simple interpolation method. The reproducibility for both methods is given, allowing for the fading after exposure as well as during the irradiation period. The characteristics of the two main glow peaks after irradiation in the monoenergetic neutron fields and also in neutron fields with varying gamma contribution are reported. The response results are discussed on the basis of Kerma in the TLD probes and the effect of charged particles created in the surrounding phantom material.

23328 (EUR—9762-Vol.2, pp 817-827) **Use of TLD-detectors for reactor mixed field dosimetry.** Apostolova, M.; Burger, G.; Combecher, D.; Eckert, H.; Kneschaurek, P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

TLD-300 (CaF2:Tm) detectors have been shown to have a LET-dependence of glow peak structure which may be used to dis-

criminate between the gamma and neutron dose components under certain conditions in mixed radiation fields. We have applied the technique to measure doses in various phantoms as well as in irradiated rat colons at the RENT-beam facility (RENT = Reactor Neutron Therapy) in Munich. About 60 detector chips were used throughout more than 40 experiments. Each mixed beam application was followed by a highly standardized Co-60 irradiation to check the remaining gamma sensitivity. The glow curves were taken in a commercial Harshaw-2000 B instrument and evaluated by a suitable code for peak analysis. From the experiments the following main results could be derived: The sensitivity of the TLD detectors decreases with each application, likely as a result of the subsequent annealing procedure. For the mixed radiation investigated no discriminatin of neutron and gamma doses is possible, due to the low sensitivity of the detectors for fission neutrons and the relatively high gamma component existent. The results show high variances, indicating that the method seems generally unsuitable for routine use without special care and precautions beeing applied. The detectors may be used for gamma dose determination, provided that the neutron dose is assessed otherwise.

23329 (EUR—9762-Vol.2, pp 829-841) **Laser heated thermoluminescence dosimetry of mixed neutron-gamma fields.** Gasiot, J.; De Murcia, M.; Al Qaralgy, R.; Chassende Baroz, P.; Serbat, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Laser heating techniques were employed to measure mixed neutron-gamma doses absorbed by thin-layer $CaSO_4$: Dy dosemeters from a Cf-252 source.

23330 (EUR—9762-Vol.2, pp 845-854) **Production by medium energy alpha-particles of strong ionizing events in composite tissue like media.** Rechenmann, R.; Wittendorp-Rechenmann, E.; Senger, B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The analysis of medium energy α particle tracks recorded in very fine grain nuclear emulsions, submitted to specific treatments enhancing the corpuscular latent image, led to the observation of strong ionizing events (SIE) sticking out of the primary's track core. Preliminary determinations showed that the number of SIE's increases with the primary's energy, and that their production is of more than one order of magnitude higher than the number of Coulombian recoils. The presence of SIE's on α tracks has also a significant influence on the first and second order moments of range, hence on the energy loss of the incoming particle, which has been determined experimentally. Measurements carried out in detectors enriched with gelatine indicate an increase of the number of SIE's, which is practically proportional to the concentration of the CNOH compound. Considering that part of these protuberances are certainly short tracks of recoil ions/nuclei ejected by elastic scattering, we have tentatively taken into account the influence of the nuclear potential on the production of heavy secondaries by adapting an optical model code to experimental data of the literature. In the case of the ejection of H-nuclei, a preliminary study by means of the optical model code indicates an increase in the number of energetic recoils, which is especially marked for the higher energies of the secondaries.

23331 (EUR—9762-Vol.2, pp 855-864) **Dosimetric characteristics of the chlorobenzene-ethanol-trimethylpentane (CET) system and DL-M4 dosimeter for neutrons produced by neutron generator and cyclotron.** Miljanic, S.; Dvornik, I.; Kadija, K.; Blagus, S.; Rendic, D. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The system 10 vol. % chlorobenzene, 10 vol. % ethanol, 2,2,4-trimethyl-pentane (the CET system) has been described in our previous publications as a new low-level chemical dosimeter which might compete with the ferrous-sulphate dosimeter as a secondary dosimetric standard. The CET system is currently used in practical dosimetry as a basis for the accident and emergeny personal dosimeter DL-M4 and for dosimetry calibration work. Exposed to the mixed neutron plus gamma field, the system measures directly the total tissue dose: the response of the CET system per gray of neutron dose in muscle tissue is nearly equal to the response per tissue gray of gamma dose for radiation energies up to 15 MeV. In this work the results of irradiations of DL-M4 dosimeters and the CET system in silica cells are compared. Optical cells with a light path of 10 cm and 1 cm were employed for irradiation and subsequent spectrophotometric measurement. The irradiations were performed by neutron generator (monoenergetic neutrons of 14.5 MeV) and cyclotron (neutrons of about 5 MeV mean energy) at the Ruder Boskovic Institute. The results show that the response of the CET system in silica cells and of DL-M4 is approximately the same for neutrons of mean energy about 5 MeV. The resulting doses are nearly tissue equivalent. For 14.5 MeV neutrons, the response of the CET system in 10 cm cells is approximately the same as in the tissue equivalent chamber, while for DL-M4 dosimeters it is about 85% of tissue dose.

23332 (EUR—9762-Vol.2, pp 865-872) **Spatial distribution of free radicals produced by neutrons.** Ettinger, K.V.; Miola, U.J.; Forrester, A.R.; Ghosh, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A number of new dosimetric techniques is based on direct (e.g.in ESR dosimetry) or indirect (e.g.in lyoluminescence dosimetry) determination of concentration of free radicals formed within the solid dosemeter by the ionizing radiation. The spatial distribution of free radicals formed in several amino acids and in certain sugars by fast neutrons was compared with the distribution obtained in irradiation with ^{60}Co gamma rays. The comparison was based on the known dependence of the microwave power saturation effect in electron spin spectrometry on the value of spin-spin relaxation constant. This relaxation constant is, in turn, a simple function of the spin density. The experimental ratios of free radical densities produced by 7.6 MeV neutrons and 1.25 MeV gamma rays are within 1.5 - 4.0. If reactor neutrons are compared with 1.25 MeV gamma rays, the ratios of radical densities are 1.4 - 3.3.

23333 (EUR—9762-Vol.2, pp 873-882) **New devices for the operational spectrometry and dosimetry of neutrons.** Mourges, M.; Carossi, J.C. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The rigourous determination of fluence rates and doses associated with neutron radiation is based on the definition of the spectrum of the source; generally, multidetector systems are employed. The multisphere system, which covers a 10 micro Sv/h to 1 m Sv/h range is the most commonly used. We have brought this system up to date by incorporating a miniaturized helium-3 counter and a new higher performance electronics with its own power supply. Some facilities such as PWR type nuclear power plants require measurement equipment capable of operating under much more intense radiation fields. We have therefore studied a portable device equipped with highly sensitive fission chambers. There are 5 different chambers with different nature fissile deposits, different numbers of electrodes and with cadmium or boron screens. This system of fissile chambers enables the differential spectrum to be determined and hence leads to information about fluence and doses: kerma, dose, dose equivalent, and quality factor. New analogue electronics enabled a portable apparatus suitable for use with all fa-

cilities with neutron dose rates in the 200 micro Sv/h to 100 m Sv/h range to be realized. An autonomous portable computer was developed using microprocessors. This computer allows measurement data from either detection system to be handled and provides in situ the spectrum and various other dosimetric data. The calculation performed is based on a linear formulation of the counting rates of the different detectors. The measurement accuracy is better than 15% for all neutron spectra between thermal and 14 MeV.

23334 (EUR—9762-Vol.2, pp 895-903) **New spectrometer to monitor a proton beam for therapy at CYCLONE (Louvain-la-Neuve).** Denis, J.M.; Lipnik, P.; Meulders, J.P.; Pirlot, R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The energy loss of high LET charged particles in tissue increases in depth and exhibits the well known sharp Bragg peak at the end of the particle trajectory. The use of this physical characteristic for therapeutic applications implies the adaptation of the Bragg peak to the extended target volume. Current techniques use space and energy modulation of the primary monoenergetic beam. In the case of the 90 MeV proton beam produced by CYCLONE at Louvain-la-Neuve (Belgium), it is considered to modulate the beam in space by beam transport elements and to modulate the beam in energy by variable absorbers. This contribution presents a spectrometer to monitor the modulated beam. It consists of 4 plastic scintillators with a continuously variable perspex absorber. The spectrometer gives three types of information: 1) The range distribution of the proton beam in a given material: logical information. 2) The energy loss as a function of penetration length: analogical information. 3) The proton energy spectrum after modulation by a NaI detector: analogical information. The actual performance of the spectrometer with respect to the 3 different types of information has been investigated for 65 MeV protons.

23335 (EUR—9762-Vol.2, pp 917-928) **Measurement of d(4)-^{9}Be neutron spectrum using a recoil proton spectrometer.** Maughan, R.L.; Roper, M.J.; Folkard, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A recoil proton telescope has been constructed in order to measure the neutron spectrum from the d(4) - Be reaction. The spectrometer consists of a self supporting polypropylene radiator of thickness 0.723 mg. cm. $^{-2}$ followed by a two-stage detector comprised of a gas-filled proportional counter and a silicon surface barrier detector. In order to achieve a lowest detectable neutron energy of 0.75 MeV allowance is made for the energy loss of the recoil protons in the radiator and in the proportional counter gas. Details of the analysis are presented. The spectrum is compared with data obtained in a preliminary measurement using a nuclear emulsion technique under similar conditions, and with data from other laboratories at incident deuteron energies of 2.8, 3.0 and 5.0 MeV. The spectrum is used to calculate neutron kerma factors and the energy to produce an ion pair (Wsub(N)); these parameters are required in neutron dose calculations. The sensitivity of these parameters to spectral changes are discussed in relation to differences between the present spectrum and that obtained in the preliminary measurement. The effect that extrapolation of the spectrum to zero energy has on these parameters is also considered. It is concluded that kerma ratios and the Wsub(N) value are not significantly effected by spectral shape at these low incident deuteron energies.

23336 (EUR—9762-Vol.2, pp 929-937) **Dosimetry intercomparison in 3 MeV and 14 MeV neutrons beams.** Medioni, R.; Spurny, F. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. (In French). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A dosimetry intercomparison was carried out between CEA Fontenay-aux-Roses and Czechoslovakia Academy of Sciences in 3,3 MeV and 14,7 MeV neutrons beams from 150 kV or 400 kV accelerators located at Fontenay-aux-Roses and Cadarache. Neutron and gamma doses at different points in the beams were measured using (TE and Al) ionization chambers, Geiger-Mueller counters and (FLI-7 and Melinex) solid detectors. The results were analyzed and compared with the values deduced from monitoring instruments and ENDIP-2 measurements.

23337 (EUR—9762-Vol.2, pp 939-947) **Use of threshold activation detectors to obtain neutron kerma for biological irradiations.** Eisenhauer, C.; Grundl, J.; Cassapakis, C.; Verbinski, V. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Fission and non-fission activation foils have been irradiated in the experimental room at the Armed Forces Radiobiology Research Institute (AFRRI) in Bethesda, Maryland, in order to characterize the neutron field there. The field, which is generated by neutrons from a TRIGA MARK-F reactor adjacent to the room, is used for radiobiological experiments. The neutron exposure parameter, neutron tissue kerma rate per unit reactor power, is derived from individual detector measurements and an a priori spectrum obtained from neutron transport calculations. Beginning with conventional averaging of single-detector results, the analysis proceeds to a least-squares adjustment which avoids spectrum interpolation. An example is included of benchmark referencing to a fission neutron spectrum and consequent improvement in measurement confidence.

23338 (EUR—9762-Vol.2, pp 949-957) **Neutron fluence and kerma free in air in a fission beam.** Koester, L.; Wagner, F.M.; Fitzek, T.; Rau, G.; Salehi, M.; Schraube, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The reactor-neutron-therapy facility of the Munich research reactor provides an intense beam of fission radiation with nearly equal intensities of the neutron and photon component, both having complex spectral structure in the energy region from 0.01 MeV up to 10 MeV. We determined the physical properties of the beam behind a 2.5 cm lead filter (RENT I) and of the unfiltered beam (RENT II) at a separation distance of 545 cm. Total neutron fluence rates (I: 1.31.108 s-1cm-2, II: 2.28.108 s-1cm-2) and the fission neutron fluence rate (I: 1.3% 0.1.10^{8} s^{-1}cm^{-2}, II: 2.3% 0.2.10^{8} s^{-1}cm^{-2}) were measured by means of the Mn-bath technique and threshold activation detectors, respectively. For the determination of the Kerma rates two pairs of neutron sensitive (t) and insensitive (u) chambers were employed. By means of measurements in the beam without and with additional thin filters of polyethylene the wall effects could be determined separately for the neutron and photon radiation components. This procedure offered the possibility to determine the chamber parameters for any mixed radiation field if the neutron sensitivity ksub(t) could be calculated for the involved fields. The kerma rates at 12kW thermal converter power were found to be for RENT I: Ksub(n) = 21.5 cGy/min and Ksub(g) = 6.4 cGy/min and for RENT II: Ksub(n) = 36.4 cGy/min and Ksub(g) = 32 cGy/min.

23339 (EUR—9762-Vol.2, pp 959-967) **Dosimetric characteristics of reactor neutron beams for radiobiological applications.** Spurny, F.; Votoskova, I. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Dosimetric characteristics of neutron beams in the biological channel of IBR-2 pulsed fast neutron reactor were studied. Experiments were performed in beams shielded by 10mm of B_4C, as well as behind combinations of polyethylene and lead filters of two different thicknesses. Studies were realized with thimble-type paired (TE - and Al-) ionization chambers, thermoluminescent and solid state nuclear track detectors. For ionization chambers, special attention was paid to current saturation corrections in pulsed beams with instantaneous dose rates up to several $Gy.s^{-1}$. Some interesting features were observed. Results obtained show that one can realize in biological channel mixed neutron-gamma beams with variable and interesting characteristics for radiobiological applications. Values of dosimetric characteristics obtained by different methods are compared, analyzed, and discussed.

23340 (EUR—9762-Vol.2, pp 1097-1106) **Use of fast neutron dosimeter diodes for in-vivo dosimetry in neutron therapy.** Page, B.C.; Bewley, D.K. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Wide based silicon diodes, in which the change in forward voltage is related to the fast neutron dose received, have been used as in-vivo dosimeters on patients undergoing neutron therapy at Hammersmith Hospital. A calibration curve showing the relationship between forward voltage and dose is established and the results from a series of exposures on patients show good agreement when compared with those obtained by the activation of indium pellets, the previous method of in-vivo dosimetry. The response of the diodes to scattered neutrons has been measured under a severe condition at a depth in water and a comparison is made between diodes, indium activation and a combination of TE ionisation chamber plus GM counter under these conditions. Details of the method used to measure the forward voltage and the subsequent annealing of the diodes are given. The simple system described measures the neutron dose with a precision of +-5%.

23341 (EUR—9762-Vol.2, pp 1179-1190) **Experimental procedures for the on-site neutron dosimetry intercomparison ENDIP-2.** Zoetelief, J.; Schraube, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

In view of the recent improvements in neutron dosimetry, it was decided by the CENDOS committee that a measuring team should visit a number of institutes, which have directly or indirectly connections with the Radiation Protection Program of the European Communities, to establish the state-of-art in the accuracy of neutron dosimetry. In four sessions, eighteen participating groups in six countries were visited. The dosimetry instrumentation included two Exradin T-2 tissue equivalent (TE) ionization chambers, an Exradin Mg/Ar chamber, a Geiger-Mueller counter, gas flow systems, two Keithley 616 electrometers, low noise cables and a Keithley 216 pA source. In addition, the same phantom, thermometer and barometer were used at all institutes. For controlling of the total dosimetry systems check source arrangements with ^{90}Sr β sources were employed. The TE gas was obtained locally whereas argon gas was part of the equipment. The results obtained with the check source arrangements (air filled an TE gas flushed systems) showed a standard deviation over the whole period of less than 1 per cent, but revealed variations in TE gas composition at some institutes resulting in differences in the reading of about 2 per cent at maximum. Where possible, the two independent TE/TE ionization chamber systems were calibrated against the local gamma ray sources. A maximum difference of about 3 per cent was observed between locally obtained calibration factors. The measurements in the neutron beams were restricted to the reference conditions of the participating institutes. The preliminary results on R'sub(T) of the participants were less than 3 per cent deviating from those of the measuring team. The preliminary results already indicate a general improvement in the accuracy of total absorbed dose determinations in mixed fields.

23342 (EUR—9762-Vol.2, pp 1191-1199) **Neutron dosimetry intercomparison between Ghent and Louvain-la-Neuve.** Strijckmans, K.; Vynckier, S.; Robert, P.; Wambersie, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A neutron dosimetry intercomparison was performed in the d(14.5) + Be neutron beam of the Ghent facility and the p(65) + Be neutron beam of the Louvain-la-Neuve facility. Total absorbed doses were measured with tissue-equivalent ion chambers belonging to both neutron therapy centers: an Exradin T2, a PTW 3301T, a Saclay parallel plate and a Saclay cylindrical ion chamber. For both beam qualities measurements were made in a polystyrene phantom at three depths. The photon calibration was done in a ^{60}Co beam with reference to UCL Baldwin-Farmer ion chambers, which have a calibration factor traceable to several standard laboratories. The tissue-equivalent ion chambers were all calibrated in air, except the parallel plate chamber, whose absorbed dose calibration factor was obtained in a polystyrene phantom. The total absorbed dose was calculated according to the ECNEU protocol. Averaged over the two beam qualities and the three depths in the phantom the results agree within 2%.

23343 (EUR—9762-Vol.2, pp 1201-1212) **Dosimetry intercomparison between Seattle, Cleveland and Louvain-la-Neuve in p(65) + Be and p (45) + Be neutron beams.** Eenmaa, J.; Horton, J.; Vynckier, S.; Octave-Prignot, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A dosimetry intercomparison was carried out between Seattle/Cleveland (US) and Louvain-la-Neuve (Belgium) at Cyclone neutron therapy facility, to verify agreement in the determination of total absorbed dose in a phantom, necessary for clinical trials. Somewhat different recommendations for the procedures and physical parameters to be employed for the determination of the total absorbed dose in a phantom are made by the European Neutron Dosimetry Group (ECNEU) and the U.S. AAPM Protocol for Neutron Beam Dosimetry. The purpose of the intercomparison was therefore to compare the experimental procedures applied by each group. Three different kinds of T.E. chambers were used: four $1cm^3$ spherical FWT (IC-17) chambers (belonging to the U.S. groups), a cylindrical 1.5 cm^3 CENF chamber and a flat, disk-shaped (2.8 cm^3, 0.46 cm gap) CENF chamber (belonging to Louvain-la-Neuve). Measurements were made in p(65)Be and p(45)Be neutron beams. The different institutes' photon calibration factors for each of the T.E. chambers were compared with a calibration factor measured in a ^{60}Co photon beam available at the Hospital St. Luc, Brussels. Furthermore, as relative dose measurements are frequently carried out with T.E. chambers filled with air instead of being flushed with T.E. gas, absorbed doses, measured with both conditions, were compared at three different depths in a polystyrene and a water phantom, and for the two neutron energies. The results of the ^{60}Co measurements show very good agreement of chamber mass-calibrations (0.998 +- 0.005). The neutron measurements indicate a different ion chamber response, depending on whether air or TE gas is used in the chambers. This is true for both phantom materials and both neutron energies. Application of physical parameters recommended by the AAPM or ECNEU to measurements by the respective groups yields good agreement (1.00 +- 0.02) in the statement of total absorbed dose.

23344 (EUR—9762-Vol.2, pp 1215-1226) **Tissue-equivalent calorimeter for direct calibration of ionization chambers in neutron beams.** Caumes, J.; Ostrowsky, A.; Steinschaden, K.; Mancaux, M.; Cance, M.; Simoen, J.P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. (In French). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The tissue-equivalent calorimeter developped at LMRI allows determination of total absorbed dose to A-150 plastic with an overall uncertainty less than 2%. Such measurements performed in an homogeneous phantom of A-150 plastic in the user's neutron beam, give the reference absorbed dose value for the calibration of medical dosimeters. The fundamental advantage of this calibration method is that it does not necessitate correction factors due to dosimetric parameters and energy spectra. Consequently it presents a higher accuracy than with procedures based on calibration in photon beams or even in neutron reference beams of different quality.

23345 (EUR—9762-Vol.2, pp 1237-1246) **Neutron dosimetry with a water calorimeter.** Galloway, G.; Greening, J.R.; Williams, J.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A water calorimeter has been used for the direct measurement of the absorbed dose to water in a fast neutron beam. The absorbed dose measured with the calorimeter was compared with that measured with an Exradin ionisation chamber, constructed of A-150 plastic. Doses measured with the water calorimeter in a d(15) + Be neutron beam were 4.3% lower than those measured with the ionisation chamber. This difference is discussed in terms of the heat defect in water, which is the largest uncertainty in the calorimetry measurement.

23346 (EUR—9762-Vol.2, pp 1247-1256) **Neutron fluence rate measurements for energies from 130 keV to 1900 keV.** Van Der Zwan, L.; Geiger, K.W. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The neutron fluence rate of monoenergetic neutrons from the $^{7}Li(p,n)^{7}Be$ reaction was measured using three different detectors: a methane filled proportional counter, a stilbene scintillator, and a calibrated Long Counter. Only the n_0 neutron group was measured; for the Long Counter the intensity of the n_1-group was subtracted using cross sections from a recent evaluation. A very light target assembly kept the scattered neutron component as low as possible. Furthermore this component was reduced by energy discrimination applied to the first two detectors listed. For the Long Counter, the scattered component was evaluated by varying the source-to-detector distance. The fluences were converted to $^{7}Li(p,n)^{7}Be$ differential cross sections and compared to the recent evaluation. Agreement between all four cross section curves was well within the uncertainties of measurement, except near the lower and upper boundaries of the neutron energies covered. The causes for the discrepancies are discussed.

23347 (EUR—9762-Vol.2, pp 1257-1266) **Neutron dosimetry measurements at the Bureau International des Poids et Mesures.** Huynh, V.D. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The measurements carried out at the Bureau International des Poids et Mesures in the field of neutron dosimetry are reported. The tissue kerma in free air, measured at 14.65 MeV with a tissue-equivalent ionization chamber and a GM counter, is compared to the kerma calculated from the measured fluence and using the Caswell-Coyne-Randolph kerma factors. A good agreement has been obtained between the two methods.

23348 (EUR—9762-Vol.2, pp 883-894) **Bubble-damage polymer detectors for neutron dosimetry.** Ing, H.; Birnboim, H.C. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A new type of direct-reading neutron dosimeter has been developed at the Chalk River Nuclear Laboratories. This detector is prepared by suspending super-heated droplets in a solid-elastic medium. In this metastable state, the droplets can be triggered by neutrons giving rise to visible vapour bubbles which are trapped at the sites of formation. The bubbles are counted to give a measure of the neutron dose. A summary of a few of the characteristics of the dosimeter is described.

23349 (EUR—9762-Vol.2, pp 1119-1128) **Time dependence of the fluence rate of thermal neutrons in a human phantom after irradiation with 15 MeV by the pulsed source method.** Reulein, W.; Kuehn, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, FR). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

An extension of the in vivo activation analysis is the investigation of the prompt gamma radiation from the (n,γ)-process for element determination. For this reason the time behaviour of the fluence rate of thermal neutrons was measured for different positions in a human phantom after irradiation with 20 micro s long pulses of 15 MeV neutrons and a period time of 1 ms. After a build-up time of 10 - 20 micro s the fluence rate of thermal neutrons decreases exponentially with time, and the half-life in the middle of the phantom shows a maximum which equals (136 +- 3) micro s for water and (119 +- 2) micro s for tissue equivalent solution. The values for other positions are given. The measurements were performed using a time to pulse height converter in connection with a multichannel analyser. The aim of this work was to get optimum conditions for application of this method in the in vivo element analysis.

23350 **(HMI-B—435) Random pulse generator with an equal amplitude distribution.** Lauch, J.; Nachbar, H.U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik). Jul 1986. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751225.

The described pulse generator produces a white pulse amplitude spectrum. Amplitudes and pulse distances are statistically distributed. The amplitude range of the output pulses, having a width of 2 μs, is 0.1 ... 10 V/sub p/. The rate may be varied from 0.1 to 110 kips. The unit has been developed for applications in nuclear physics. It will mainly be used to test large experiment setups and for calibration of parameters. In some cases, measurement of nonlinearities will be possible. Distortions of the event spectrum may occur, if random pulses are supplied to an ADC with dead time depending on pulse amplitude. These distortions are calculated and discussed. Problems during development are shown.

23351 **(INIS-BR—579) Energy dependence of ionizing radiation in AGFA-GEVAERT dosimetric film.** Las, W.C. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1985. 14p. (In Portuguese). (CONF-8509375—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701618.

From 6. Brazilian seminar of non-destructive tests; Belo Horizonte, Brazil (1 Sep 1985).

Agfa-Gevaert radiographic films used in personnel dosimetry are evaluated at IPEN (Instituto de Pesquisas Energeticas e Nucleares-CNEN/SP) using a calibration curve obtained with gamma

radiation exposure films of /sup 60/Co (1250 KeV). As the film presents a strong energy dependence, it is necessary to determine the energy which film was exposed to make a correct dose evaluation. Curves of energy dependence are obtained for two filtering conditions of dosemeter, and results are applied in dose determination of the two dosemeters, one personnel and other environmental. The correction factors are 3.7 and 2.5, respectively, for these two dosemeters. (M.C.K.).

23352 (INIS-mf—10339) **Construction, optimization, and test of a polarimeter for the measurement of the neutron-proton polarization-transfer coefficient D/sub t/.** Wingender, K. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 27 Jun 1985. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751315.

The present thesis describes conception, optimization, and test of a proton polarimeter for the determination of the neutron-proton polarization-transfer parameter D/sub t/. As for its measurement three reactions (production of the neutrons via D(d,n)/sup 3/He; polarization transfer in a np scattering; detection of the proton polarization by elastic p-/sup 12/C scattering) are used, the apparature was to be carefully optimized in order to get in capable measuring times statistically significant results. The design of the polarimeter was therefore performed by means of a simulation program especially fitted to the experiment by which the optimal experimental parameters were stated. Furthermore by this the experimentally hardly accessible effective analyzing power of the facility was determined to A/sub eff/=-0.242. At several test-beam times the polarimeter fulfilled the expectations completely. The measured spectra permit a practically background-less determination of the left-right asymmetry. At a polarized beam current of 1μA in 2 weeks of beam time by the recent apparature D/sub t/ can be determined to +- 0.03 which allows a determination of the /sup 3/S/sub 1/-/sup 3/D/sub 1/ mixing parameter ϵ/sub 1/ to +- 1.5/sup 0/.

23353 (INIS-mf—10581, pp 175-177) **New PIXE/PIGME analysis facility.** Garton, D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A new PIXE/PIGME ion beam facility is being developed for use on the 3MeV Van de Graaff accelerator. It will be used to analyse geological samples prepared on microscope slides. The samples will be movable in the X and Y axis using remote or computer controlled motorised micrometers. Other features of the rig include remote selection of X-ray detector filters and beam defining apertures. Beam current monitoring is by backscattering, whilst target positions are determined optically using a variable gain borescope. The rig will be a useful tool when analysing very small targets or when target scanning is necessary.

23354 (INIS-mf—10589, pp 69-70) **Fission neutron time-of-flight spectrometer.** Duka-Zolyomi, A.; Kliman, J. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23355 (INIS-mf—10589, pp 77-78) **Background suppression in large low-level shield.** Durana, L.; Chudy, M.; Povinec, P.; Stanicek, J.; Sivo, A.; Usacev, S.; Emrich, P.; Janik, R. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Komenskeho Univ., Bratislava, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23356 (INIS-mf—10589, pp 89-90) **Preparation of carbon polarimeter for fast neutrons.** Bem, P.; Hoffman, J.; Presperin, V.; Vincour, J.; Kozma, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23357 (INIS-mf—10589, pp 114-115) **Point model for calculating Ge(Li) detector efficiency for energy region 0.4 to 1.3 MeV.** Slavik, O. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23358 (INIS-mf—10589, pp 121-122) **Telescope for study of (n,α) reactions.** Holy, K.; Florek, M.; Oravec, J.; Szarka, I. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23359 (INIS-mf—10589, pp 104-105) **Search for n-n-bar oscillations by measurement of nucleon emission from n-bar annihilations in the nucleus.** Saro, S. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23360 (INIS-mf—10589, pp 73-74) **Discontinuous method of /sup 3/H, /sup 14/C, /sup 85/Kr and /sup 133/Xe activity measurement in nuclear power plant stack.** Cimbak, S.; Povinec, P.; Janecka, S.; Moravek, J. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23361 (INIS-mf—10589, pp 85-86) **Optical bench measurements of ionizing radiation characteristics.** Kvetan, K.; Cernansky, P. (Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Strojnicka Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23362 (INIS-mf—10589, pp 94-95) **Foils of AgCl(Cd) as charged particle track detectors.** Bradnova, V.; Jukl, F.; Kulikova, S.I.; Lomova, L.A.; Nevzorova, N.M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23363 (INIS-mf—10589, pp 96-97) **Multiwire position sensitive chambers operatred with low pressure isobutane.** Netusil, T.; Moucka, L. (Joint Inst. for Nuclear Research, Dubna, USSR; Vyzkumny Ustav Energeticky, Bechovice, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23364 (KFK—4010-B) Investigation of the ion-optical properties of the magnetic spectrometer LEPS. Metzler, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Apr 1986. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751180.

This report deals with the analysis of the ion-optical properties of the magnetic spectrometer LEPS to be used for the study of low-energy pion nucleus scattering at SIN. The spectrometer consists of a splitpole preceeded by a quadrupoletriplet, imaging the target spot of the dispersed beam onto the intermediate focus detector in front of the splitpole. The momentum of the incident pion is thus determined with the spectrometer itself. The momentum of the scattered particle is determined by a coordinate measurement in the focal plane of the splitpole and a simultaneous measurement of the coordinates and angles in the intermediate focus detector in order to correct for higher order aberrations. The imaging of the quadrupoletriplet was investigated experimentally with α-particles from an Am/sup 241/ source.

23365 (KFK—4119) Performance test of a TMS calorimeter. Wild, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Oct 1986. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751206.

Performance tests of a first calorimeter module using the room temperature liquid tetramethylsilane (TMS) as active element are described in detail. As absorber planed carbon steel slabs had been used. The charge yield is 70% of that in a very pure sample of the liquid. A long term stability of the signal with a lifetime of half a year has been realized. Experiences are described and the results explained in detail.

23366 (MPI-PAE/Exp.El.—160) Laboratory study of radiation damage to drift chambers. Kotthaus, R. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Feb 1986. 34p. (CONF-860162—7). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751228.

From Workshop on radiation damage to wire chambers; Berkeley, CA, USA (16 Jan 1986).

A laboratory study of aging effects under intense radiation in Ar/C/sub 2/H/sub 6/ and Ar/CO/sub 2//CH/sub 4/ filled drift chambers was carried out in order to establish detector lifetimes. In both gas mixtures stable operation in proportional mode and for Ar/C/sub 2/H/sub 6/ also in the limited streamer regime was possible up to total collected charges of several times 10/sup 17/ e/sup -/ per mm of anode wire. Gain reductions were observed at rates between 0 and 1% per 10/sup 16/ e/sup -//mm for Ar/C/sub 2/H/sub 6/ depending on the test conditions. At conditions, where gas amplification was stable in Ar/C/sub 2/H/sub 6/, gain losses in Ar/CO/sub 2//CH/sub 4/ ranged between 1.3 and 3.4% per 10/sup 16/e/sup -//mm. Gain nonuniformities were inferred from broadenings and distortions of the Fe/sup 55/ 5.9 keV γ line. These gain variations are caused by typically less than 100 nm thick deposits on the aged anode wires of poorly conductive material containing O, Si and C. Admixtures of H/sub 2/O did not halt the aging processes, but smoothed local gain variations. Contaminations with organic vapor from soft PVC surfaces initiated and accelerated radiation damage. Spark and glow discharges in Ar/C/sub 2/H/sub 6/ within minutes led to growth of grains and flakes of material containing C as the only detectable element on anode and cathode wires. In contrast discharges in Ar/CO/sub 2//CH/sub 4/ did not result in any detectable deposits.

23367 (OUP—86-26) Thermoluminescence albedo-neutron dosimetry. Strand, T.; Storruste, A. (Oslo Univ. (Norway). Fysisk Inst.). Oct 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750693.

The report discusses neutron detection with respect to dosimetry and compares different thermoluminescent dosimetry materials for neutron dosimetry. Construction and calibration of a thermoluminescence albedo neutron dosemeter, developed by the authors, is described. 38 refs.

23368 (PTB-FMRB—108) Covariance matrix of neutron spectra used in the REAL 84 exercise. Matzke, M. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Forschungs- und Messreaktor). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751226.

Covariance matrices of continuous functions are discussed. It is pointed out that the number of non-vanishing eigenvalues corresponds to the number of random variables (parameters) involved in the construction of the continuous functions. The covariance matrices used in the REAL 84 international intercomparison of unfolding methods of neutron spectra are investigated. It is shown that a small rank of these covariance matrices leads to a restriction of the possible solution spectra.

23369 (PTB-ND—28) Influence of neutron spectra and fluence response data on the determination of dose equivalent with Bonner spheres. Alevra, A.V.; Siebert, B.R.L. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Neutronendosimetrie). Oct 1986. 125p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87751222.

A formalism is presented which allows a concise interpretation of measurements with Bonner spheres in order to determine dose equivalent. Five sets of response functions given in the literature are presented and intercompared. A set of nine neutron spectra is introduced, which enables most of the radiation protection environments to be described by appropriate linear superpositions.

23370 (STUK-A—53) Testing of radiotherapy dosimeters in accordance with IEC specification. Jaervinen, H.; Rantanen, E.; Jokela, K. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Aug 1986. 93p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750678.

Two common type of docimeters (chamber + measuring assemblies) for use as field instruments in radiotherapy were tested in accordance with the specifications by the International Electrotechnical Commission (IEC). The influence of external electromagnetic fields was determined based on own specifications. The test methods and equipment are shortly commented (for external fields test in full details), and the results are presented in details. The results indicate that the dosimeters comply quite well with the requirements by the IEC, while the information supplied with the dosimeters is quite inadequate. The results of external fields tests indicate that the dosimeters may be distrubed by external electromagnetic fields below the susceptility level generally applied to sensitive electronic measuring devices, but the possible effects can be immnoticed by totally erroneous readings.

23371 Organic metal neutron detector. Butler, M.A.; Ginley, D.S. (to Dept. of Energy, Washington, DC). US Patent 4,641,037. 3 Feb 1987. Filed date 21 Nov 1984. vp.

A device is described for detection of neutrons, comprising: as an active neutron sensing element, a conductive organic polymer having both electrical conductivity and a cross-section for the neutrons such that a detectable semi-permanent change in the conductivity is caused through impingement of the neutrons on the organic polymer; means operatively associatable with the conductive organic polymer, which is responsive to a property of the polymer altered by impingement of the neutrons on the polymer; and means for associating a permanent or semi-permanent change in the conductivity with the presence of neutrons at the location of the device.

23372 Fast signal calibration systems for large detector system front ends. Lo, C.C.; Kirsten, F.A.; Nakamura, M. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 266-270(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

The fast risetime of the calibration signal in a 10 ns front end of a large detector system presents problems not generally encountered in a slower system. The distribution of these signals also presents its own unique set of problems. The authors have arrived at solutions which are applicable to large systems requiring fast risetime calibration signals in a small volume of space.

23373 **The data acquisition system for SLD.** Sherden, D.J. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 142-150(Feb 1987). (CONF-861007—). Contract AC03-76SF00515.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

This paper describes the data acquisition system planned for the SLD detector, which is being constructed for use with the SLAC Linear Collider (SLC). Analog electronics, heavily incorporating hybrid and custom VLSI circuitry, is mounted on the detector itself. Extensive use is made of multiplexing through optical fibers to a FASTBUS readout system. The low repetition rate of the SLC allows a relatively simple software-based trigger. Hardware and software processors within the acquisition modules are used to reduce the large volume of data per event and to calibrate the electronics. A farm of microprocessors is used for full reconstruction of a sample of events prior to transmission to the host.

23374 **Analog data transmission via fiber optics.** Cisneros, E.L.; Burgueno, G.F. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 175-178(Feb 1987). (CONF-861007—). Contract AC03-76SF00515.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

In the SLAC Linear Collider Detector (SLD), as in most high-energy particle detectors, the electromagnetic noise environment is the limiting factor in electronic readout performance. Front-end electronics are particularly susceptible to electromagnetic interference (EMI), and great care has been taken to minimize its effects. The transfer of preprocessed analog signals from the detector environs, to the remote digital processing electronics, by conventional means (via metal conductors), may ultimately limit the performance of the system. Because it is highly impervious to EMI and ground loops, a fiber-optic medium has been chosen for the transmission of these signals. This paper describes several fiber-optic transmission schemes which satisfy the requirements of the SLD analog data transmission.

23375 **A remotely-operated low background germanium multi-detector spectrometer system logistical aspects of the design.** Goulding, F.S.; Cork, C.A.; Landis, D.A.; Luke, P.N.; Madden, N.W.; Malone, D.F.; Pehl, R.H.; Smith, A.R. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 213-221(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A system of data acquisition, data analysis, monitoring and gain stabilization used in a long-term, low background germanium double beta decay experiment is described. This system, which is essential to the remote underground operation of the spectrometer, may provide a model for similar experiments.

23376 **High Speed Video Data Acquisition System (VDAS) for H.E.P., including Reference Frame Subtractor, Data Compactor and 16 megabyte FIFO.** Knickerbocker, K.L.; Baumbaugh, A.E.; Ruchti, R.; Baumbaugh, B.W. (Fermi National Accelerator Lab., Batavia, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 245-249(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A Video-Data-Acquisition-System (VDAS) has been developed to record image data from a scintillating glass fiber-optic target developed for High Energy Physics. VDAS consists of a combination flash ADC, reference frame subtractor, high speed data compactor, an N megabyte First-In-First-Out (FIFO) memory (where N is a multiple of 4), and a single board computer as a control processor. System data rates are in excess of 30 megabytes/second. The reference frame subtractor, in conjunction with the data compactor, records only the differences from a standard frame. This greatly reduces the amount of data needed to record an image. Typical image sizes are reduced by as much as a factor of 20. With the exception of the ECL ADC board, the system uses standard TTL components to minimize power consumption and cost. VDAS operation as well as enhancements to the original system are discussed.

23377 **The Digital Correction Unit: A data correction/compaction chip.** Mac Kenzie, S.; Nielson, B.; Paffrath, L.; Russell, J.; Sherden, D. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 250-252(Feb 1987). (CONF-861007—). Contract AC03-76SF00515.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

The Digital Correction Unit (DCU) is a semi-custom CMOS integrated circuit which corrects and compacts data for the SLD experiment. It performs a piece-wise linear correction to data, and implements two separate compaction algorithms. This paper describes the basic functionality of the DCU and its correction and compaction algorithms.

23378 **Removal of phototubes from Pb—glass detectors.** Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Review of Scientific Instruments;* **58**: No. 1, 143-144(Jan 1987). Contract AC02-76CH00016.

A simple procedure is described for removing faulty photomultiplier tubes from Pb—glass detectors by means of heated chloroform.

23379 **Use of wire chambers in structural biology.** Schoenborn, B.P.; Schefer, J.; Schneider, D.K. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **252**: No. 2/3, 180-187(1 Dec 1986). (CONF-860272—).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

Position-sensitive neutron detectors with high detection efficiency and high spatial resolution are essential for neutron protein crystallography as well as for small-angle neutron scattering on large biological assemblies. Here the authors report on the performance of two wire chambers recently developed by the Brookhaven Instrumentation Division. Both detectors have a spatial resolution of about 1.3 mm, a detection efficiency of about 80%, and excellent differential and integral linearities. Using small-angle data as an example, it is shown that the new detectors, furthermore, have excellent temporal stability and can provide difference spectra of unparalleled accuracy. The Biology small-angle spectrometer, because of its location on the constrained reactor floor, has a short secondary flight path of 2 m. High detector resolution is therefore essential to preserve the ability to measure at small angles and to record narrowly spaced diffration fringes. In addition, it is demonstrated in detail that the state-of-the-art detector makes it possible to extend the precision and resolution of a protein single-crystal data set. By measuring beam divergence, wavelength spread, and the crystal mosaic in auxiliary experiments, a set of parameters is obtained for the calculation of a spatial filter for each diffraction spot.

23380 **Multiwire proportional chamber based system for digitizing electrophoretic gels.** Lillberg, J.W.; Kinnison, W.W.; McKee, R.J.; Anderson, H.L. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **252**: No. 2/3, 251-254(1 Dec 1986). (CONF-860272—).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

A system for studying proteins that utilizes a multiwire proportional chamber is described. Essential elements of this system are a strong magnetic field and a high-speed bit-slice preprocessor-based data-acquisition system.

23381 **Detection of charged particles in amorphous silicon layers.** Perez-Mendez, V.; Morel, J.; Kaplan, S.N.; Street, R.A. (Lawrence Berkeley Lab., CA; Xerox Palo Alto Research Center, CA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **252**: No. 2/3, 478-482(1 Dec 1986). (CONF-860272—).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

Also published as report LBL--20664; CONF-860272—72--7; CONF-8603109--2.

The successful developemnt of radiation detectors made from amorphous silicon could offer the possibility for relatively easy construction of large-area position-sensitive detectors. The authors conducted a series of measurements with prototype detectors on signals derived from alpha particles. The measurement results are compared with simple model calculations, and projections are made of potential applications in high-energy and nuclear physics.

23382 **Performance of a novel silicon detector.** Beuttenmuller, R.; Kraner, H.W.; Ludlam, T.W.; Polychronakos, V.A.; Radeka, V.; Chesi, E.; Fabjan, C.W.; Piuz, F.; Russ, J.S.; Tschulik, A. (Brookhaven National Lab., Upton, NY; European Organization for Nuclear Research, Geneva, Switzerland). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **252**: No. 2/3, 471-477(1 Dec 1986). (CONF-860272—).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

The performance of a silicon detector with two-dimensional pad readout, intended to be used in the trigger of experiment HELIOS (NA34), was investigated in a proton/pion beam of 200-GeV/c momentum at the CERN SPS. The data can be described by the convolution of the Landau distribution with a Gaussian, taking into account long-distance collisions and electronics noise. Uniformity in peak loss was found to be better than 7%. The response for single tracks through the detector is characterized by the total number of pads with a threshold value (multiplicity), and the number of adjacent pads, responding to a single particle (cluster size). Data on multiplicity and cluster size as a function of threshold is discussed. Detection efficiency for particles was measured over the pad area and across the pad boundaries.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

23383 **(AD-A—175977/8/XAB) Radiation threshold levels for noise degradation of photodiodes. Technical report.** Aukerman, L.W.; Vernon, F.L.; Song, Y. (Aerospace Corp., El Segundo, CA (USA). Electronics Research Lab.). 30 Sep 1986. 33p. (TR—0086(6925-04)-2). NTIS, PC A03/MF A01.

Space radiation can increase the noise of photodiodes as a result of either a sustained ionizing-dose-rate effect or displacement damage. Elementary, straightforward models are presented for calculating radiation threshold levels and rad hit susceptibility. Radiation-effects experiments that verify these models are discussed. Calculations for room-temperature silicon p-i-n photodetectors, an avalanche photodiode, and a hypothetical cooled staring detector indicate that this damage mechanism should not be ignored for space and nuclear environments.

23384 **(SAND—86-7174) Extended steady-state analysis of the gamma-irradiated Cartesian P-N junction.** Stuetzer, O.M. (Mission Research Corp., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006332.

A steady-state analysis of a gamma-irradiated Cartesian P-N junction is presented that takes into account (1) carrier lifetime variation with radiation density; (2) electric fields in quasi-neutral regions; (3) the effects of voltage drops in the junction as well as in a load resistor; and (4) the influence of electrodes, which are characterized by effective surface recombination velocities. For silicon devices, the model predicts superlinear radiation response for back-biased diodes, radiation response decreasing with increasing forward bias, and possible radiation current-sign reversal for high forward bias. Measurements on actual devices are discussed.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 22787, 23086, 23210, 23984

23385 **(BDX—613-3669) Particle and fiber identification by optical microscopy: Final report.** Harding, W.B. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Mar 1987. Contract AC04-76DP00613. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006883.

The use of optical microscopy for the identification of particulate and fibrous contaminants is explained. Methods are described for acquiring the contaminants from product and other locations and for preparing them for examination. Examples of the applications of optical microscopy to problems are presented.

23386 **(DOE/MC/22184—2280) Evaluation of the laser Doppler velocimeter for particle sizing: Topical report.** Giel, T.V. Jr.; Son, J.Y. (Tennessee Univ., Tullahoma (USA). Space Inst.). Jan 1987. Contract AC21-85MC22184. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001069.

Measurement techniques for in-situ simultaneous measurements of particle size distributions and particle velocities using the dual beam laser Doppler velocimeter (LV) were investigated. This investigation concentrated on examination of the different signal characteristics of the LV for extraction of both particle size and particle velocity. These different signal components were evaluated not only singularly but also as sets of multiple simultaneous measurements to determine which characteristic, or combination of characteristics, provides the best measure of particle size. Different components of the LV signal were considered, but analysis concentrated on Doppler phase angle, visibility, and scatter-intensity because they show the greatest promise. Because LV signal characteristics are not monotonic functions of the particle size parameter, the resulting uncertainties introduced in the size-signal relationship were identified for the signals for both separate and simultaneous measurements. Uncertainties introduced by multiple particle indices of refraction were also evaluated. Finally, uncertainties resulting from particle trajectory variations in the spatially nonuniform LV probe volume were considered. No one signal characteristic or optical configuration was found which would minimize all uncertainties, but optimal configurations were identified for selected applications. Experimental verification and further optimization are recommended. The most promising instrument should be designed and tested to perform this validation, while allowing experimental comparisons of possible instrument configurations and developing instrument design concepts.

23387 **(DOE/PC/90961—T2) Laser velocimeter measurements of solids in multiphase flow: Quarterly technical progress report covering the period December 1, 1986 to February 28, 1987.** Kadambi, J.R. (Case Western Reserve Univ., Cleveland, OH (USA)). 1987. Contract FG22-86PC90961. 10p. NTIS, PC A02. File Number DE87007380.

The literature survey conducted in the area of multiphase flow containing solids indicated about 89 papers in the general area. Detailed examination of these papers indicated that seventeen papers were of interest in our area of work, solids in liquid flow. A list of these papers is enclosed along with this report. The papers can be classified into two categories: (1) papers reporting relevant experimental work in the solid-liquid multiphase flow (references 1 through 10): (a) Laser Doppler velocimeter based work (references 1 through 7), and (b) other experimental work (references 8 through 10); and (2) papers in the area of theoretical, analytical,

and modelling of solid-liquid multiphase flows (references 11 through 17). Table 1 provides in a tabular form, the ranges and details of the work reported in these references. In addition to the reference, the table provides details of flow configuration, solid and fluid characteristics (material, size, etc.), solid concentrations and Reynolds number and/or average velocities. Plots of available data for Reynolds number versus solid concentration, and Reynolds number versus solid to liquid density ratios are shown in figures 1 and 2.

23388 **(Y/DW—638) Variable dead time compensation and calculation of salt-acid concentration ratio improves evaporator control.** Mee, D.K.; Asbury, W.L.; Kaiser, K.W.; Orejuela, M. (Oak Ridge Y-12 Plant, TN (USA)). 29 May 1986. Contract AC05-84OS21400. 23p. (CONF-861039—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005913.

From Instrument Society of America international conference and exhibit; Houston, TX, USA (13 Oct 1986).

Control of the salt-to-acid concentration ratio in an evaporator has proved to be a difficult problem at the Oak Ridge Y-12 Plant. Rugged online measurement techniques had to be developed for the determination of salt and acid concentrations. A control scheme also had to be developed to cope with the large dead times present in a pilot-plant evaporator. To address the concentration measurement problem, density and conductivity measurements were interfaced to a microcomputer which was used to calculate salt and acid concentrations. Dead times which approached the process time constant in magnitude caused a standard PI controller to produce unacceptable undershoots of 25%. To address this problem, a dead time compensation scheme utilizing a first-order process model with variable dead time was implemented in the microcomputer. Control with dead time compensation dramatically improved the performance with the virtual elimination of undershoot. This paper discusses the development of both online measurements and variable dead time compensation used in the evaporator control.

23389 **Calibration of mass spectrometers for quantitative gas mixture analysis.** Ellefson, R.E.; Cain, D.; Lindsay, C.N. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 1, 134-139(Jan 1987). Contract AC04-76DP00053.

Quantitative analysis of gas mixtures from sources external to a mass spectrometer (MS) requires vacuum hardware that systematically introduces the gas to the ionization region of the MS and calibration procedures that reflect the MS response to time dependent partial pressures in the gas source. Formalism for describing the gas flow, fractionation processes, and the ionization process is presented. Long-term sensitivity data for D_2 is presented for three types of mass spectrometers: a quadrupole, a cycloid, and a magnetic sector mass spectrometer. The use of appropriate standard gas mixtures to monitor the accuracy of the MS calibration by control chart is advocated. Bias data from control charts can be used as the basis for minor calibration adjustments rather than total recalibration.

23390 **Ion signal calibration in the imaging atom-probe with an external, time-gated image intensifier.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **58**: No. 1, 38-42(Jan 1987). Contract AC04-76DP00789.

A commercial, external image intensifier unit has been adapted to an imaging atom-probe mass spectrometer. The image intensifier can be operated in a pulsed mode to obtain time-gated (i.e., species specific) images while simultaneously recording time-of-flight mass spectra. This capability was used to calibrate the amplitudes of rhodium, tungsten, and neon ion signals which appear in imaging atom-probe mass spectra. The signal amplitudes were found to be directly proportional to the number of imaged ions over a range of amplitudes covering three orders of magnitude. The proportionality constant was found to be nearly the same for doubly charged rhodium and triply charged tungsten ions, but significantly different for neon ions. The constant was not sensitive to variations of —30% in the applied voltage (i.e., ion energy).

23391 **(LA-tr—87-9) Optico-mechanical scanning radiometer.** Kupriianov, I.K.; Lustberg, E.A.; Lapushkin, N.S.; Koroleva, A.V.; Galpern, A.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. Translation of Russian Patent No. 236,807, 2 October 1969. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007075.

An opto-mechanical scanning radiometer is described. The optical systems (lenses and mirrors) are installed on a rotating drum so that the focal planes of all elements are coincident with the axis of rotation. The sensitive surface of the photodetector is located on the axis of rotation and is coupled to a drive system which displaces it along the axis synchronously with the drum's rotation. The optical systems turn about the axis of rotation in a plane at an angle equal to one-half the field of view of each objective for the purpose of simplification of the scanning mechanism and increasing coordinate reading accuracy. (JDH)

23392 **Method and apparatus for optical temperature measurements.** Angel, S.M.; Hirschfeld, T.B. (to Dept. of Energy). US Patent Application 6-854,631. 22 Apr 1986. 21p. Contract W-7405-ENG-48. DE87007236 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007236.

A method and apparatus are provided for remotely monitoring temperature. Both method and apparatus employ a temperature probe material having an excitation-dependent emission line whose fluorescence intensity varies directly with temperature whenever excited by light having a first wavelength and whose fluorescence intensity varies inversely with temperature whenever excited by light having a second wavelength. Temperature is measured by alternatively illiminating the temperature probe material with light having the first wavelength and light having the second wavelength, monitoring the intensity of the successive emissions of the excitation-dependent emission line, and relating the intensity ratio of successive emissions to temperature. 3 figs.

23393 **Isotopic analysis of nanogram quantities of plutonium by using a SID ionization source.** Perrin, R.E.; Knobeloch, G.W.; Armijo, V.M.; Efurd, D.W. (Los Alamos National Lab., NM). *International Journal of Mass Spectrometry and Ion Processes;* **64**: 17-24(1985).

A surface ionization-diffusion-type ionization source which uses a rhenium filament overplated with platinum has been developed and optimized for analyzing plutonium samples of 0.5-2 ng. This source is capable of measuring the $^{240}Pu/^{239}Pu$ atom ratio to 0.07% precision and accuracy at the 95% confidence level. 6 references, 3 figures, 2 tables.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 22182

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 23733

23394 **(LA—10894-MS) Long range plan for explosives technology group (M-1).** Taylor, G.W.; Rivera, T. (Los Alamos National Lab., NM (USA)). Apr 1987. 12p. NTIS, PC A02/MF A01. File Number DE87007714.

Group M-1 is responsible for the research and development of new explosives and other materials for weapons application and for the reliability assurance of materials in the current stockpile. This report examines the group's future role in this technology, as well as its expansion into other areas in which the Los Alamos National Laboratory may be involved. This report also recommends actions that may be currently implemented to help Group M-1's mission remain current and useful.

23395 (UCRL—91483) Modeling 1-D deflagration to detonation transition (DDT) in porous explosive. Weston, A.M.; Lee, E.L. (Brobeck, Inc., Berkeley, CA (USA); Lawrence Livermore National Lab., CA (USA)). 4 Apr 1985. Contract W-7405-ENG-48. 11p. (CONF-850706—34). NTIS, PC A02. File Number DE87007100.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

A one-dimensional Lagrange hydrodynamic computer model is presented that describes gas flow, compaction, ignition, and deflagration processes in deformable porous beds. The model makes use of a consumable finite element cell that allows gas to flow through a compacting matrix. The model can be regarded as structural in the sense that the initial cell dimension is directly related to mean particle size. Experimental investigation of the DDT phenomenon are typically carried out using long thick-walled tubes filled with a granular porous bed of reactive material. In this configuration, much of the process can be described by flow in one dimension. We present calculations that simulate both squib initiated and piston initiated experiments on porous HMX to point out various observed features. Our purpose is to establish a basis for setting bounds on the physical parameters that describe such transient reaction processes. 16 refs., 17 figs., 1 tab.

23396 Simulation of shock-induced energy flux in molecular solids. Karo, A.M.; Walker, F.E.; DeBoni, T.M.; Hardy, J.R. (Lawrence Livermore National Lab., CA). *Progress in Astronautics and Aeronautics;* **94**: 405-415(1985). Contract W-7405-ENG-48.

From 9. ICODERS; Poitiers, France (3-8 Jul 1983).

Computer molecular dynamics has been used to study the time evolution of the energy of diatomic molecules embedded in a monatomic host lattice when the system is shock loaded. Center-of-mass, rotational, and internal energies were each monitored. For H_2 and CH groups in an iron host, the results demonstrate rapid and violent internal excitation of a totally athermal nature. The origins of this are discussed as are the reasons for the absence of a similar effect for a CH group in a carbon lattice. From these results for diatomic systems, it is argued that large molecules, similarly treated, may easily be excited to the point of rupture. If they are so situated (e.g., at or near a surface) that during, or shortly after, excitation they escape from the lattice, they will rupture rather than de-excite and thus generate molecular fragments (e.g., free radicals) that could, in the case of an explosive system, serve to initiate detonation. 9 references, 5 figures.

23397 Solid state products of the thermal decomposition of confined and unconfined triaminotrinitrobenzene. Catalano, E.; Rolon, C.E. (Lawrence Livermore National Lab., CA). *Thermochimica Acta;* **61**: 53-71(1983). Contract W-7405-ENG-48.

The solid state products formed by the thermal decomposition of triaminotrinitrobenzene (TATB) were examined using infrared spectroscopy and optical and scanning-electron microscopy (SEM). Several phases were observed in condensates and residues from unconfined decompositions. The residues from confined decompositions show that very little decomposition occurs until times near the time to explosion. A model for the unconfined decomposition is presented. 16 references, 9 figures, 3 tables.

4502 Nuclear

REFER ALSO TO CITATION(S) 23383

23398 (AD-A—175839/0/XAB) Neutron exposure for DOD (Department of Defense) nuclear test personnel. Technical report, 15 June-15 December 1984. Goetz, J.; Klemm, J.; Thomas, C.; Weitz, R. (Science Applications International Corp., McLean, VA (USA)). 15 Aug 1985. 38p. (SAIC—85/1814). NTIS, PC A03/MF A01.

Neutron doses for DOD units/projects that participated in atmospheric nuclear test programs are assessed using computer codes ATR and ANISN. Units/projects whose personnel are identified as having received a neutron dose of at least 1 mrem are listed by operation and shot. Of the several thousand units/projects screened, 160 are identified as having received a free-field neutron exposure exceeding 1 mrem. Of these, approximately 75% are aircrews with the remainder being ground-based units, either scientific projects or military observer/maneuver units.

23399 (NVO—209-Rev.7) Announced United States nuclear tests, July 1945 through December 1986. (USDOE Nevada Operations Office, Las Vegas). Jan 1987. 76p. NTIS, PC A05. File Number DE87006773.

All nuclear tests conducted and announced by the United States from July 1945 through December 1986 are listed chronologically and alphabetically by event name, with the exception of the GMX experiments. The listing for each event provides the event name, date, location, type of test, purpose, and yield range. Total numbers of tests are also given by year, type, detection of radioactivity, location, and purpose. (LEW)

23400 (SAND—87-0445C) Effect of the fast nuclear electromagnetic pulse on the electric power grid nationwide: A different view. Rabinowitz, M. (Electric Power Research Inst., Palo Alto, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-870203—4). NTIS, PC A02. File Number DE87006135.

From Institute of Electrical and Electronic Engineers/ Power Engineering Society winter meeting; New Orleans, LA, USA (1 Feb 1987).

This paper primarily considers the potential effects of a single high-altitude nuclear burst on the US power grid. A comparison is made between electromagnetic pulse(EMP) and natural phenomena such as lightning. This paper concludes that EMP is no more harmful to the power grid than its counterparts in nature. An upper limit of the electric field of the very fast, high-amplitude EMP is derived from first principles. The resulting values are significantly lower than the commonly presented values. Additional calculations show that the ionization produced by a nuclear burst severely attenuates the EMP. 21 refs., 2 figs., 6 tabs.

23401 (UCID—20837) Nuclear Test Program. Ferderber, L.j.; Adye, P.; Bruner, J.M.; Clements, W.; de Vore, L.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (eds.). (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005595.

An interview with Dr. Robert W. Kuckuck, Deputy Associate Director for Nuclear Testing, is presented which surveys the Lawrence Livermore National Laboratory's efforts in nuclear testing, the need for testing, and the role of testing in the overall weapon design process. The complex activities coordinated in the fielding of a nuclear test at the Nevada Test Site are described. Advances in nuclear testing technology are highlighted, including: x-ray spectroscopy, development of electro-optical data transmission systems, electro-optical downhole imaging systems, image data acquisition, diagnostics using charged-particle detectors, analyzing of radioactive nuclides, isotope mass spectrometry for nuclear test diagnostics, canister design, emplacing nuclear event cables with an automated system, the digital downhole surveyor, and measurements on subsurface rock. (LEW)

23402 (UCID—20878) Why nuclear testing is necessary: A nuclear weapon scientist's perspective. Cochran, S.G. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006306.

Nuclear testing is receiving much public attention recently because of the Soviet moratorium. From a nuclear weapon scientist's perspective, nuclear tests are essential to maintain the credibility of the US nuclear deterrent. Nuclear tests are necessary for modernization of weapon systems in a world of rapidly advancing technology and changing conditions; they are necessary for ensuring that weapons are safe from accidental detonation; and they are necessary for determining that weapons are reliable and will perform as designed. Whereas nonnuclear tests and computer simulations are valuable tools, there is no substitute for experimental data from nuclear tests. Nuclear testing is required to maintain the

competence of weapon scientists and engineers, is the only way they can gain necessary experience, and verifies the adequacy of their judgments. Confidence in US nuclear forces now and in the future is based on the competence of weapon scientists and engineers. As long as the nuclear deterrent continues to be the major ingredient in US defense policy, a Comprehensive Test Ban is not in the US interest.

23403 **(UCRL—15860-Vol.1) Preliminary computer analysis of a planned LLNL UGT.** Hollis, D.; Reed, L. (S-Cubed, La Jolla, CA (USA); Lawrence Livermore National Lab., CA (USA)). 15 Oct 1985. Contract W-7405-ENG-48. 16p. (SSS-R—86-7546). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006717.

A calculational investigation of a possible threat to closure hardware due to plasma generation in the line-of-sight pipe for a planned underground test is described. One calculation included both direct energy into the line-of-sight pipe and thermal radiation as energy sources, and another had only thermal canister radiation as its source in order to assess the relative influence of these two sources. Results indicate potentially threatening flow in both cases, and some type of closure mechanism to reduce pipe flow and minimize the threat is recommended. (LEW)

23404 **(UCRL—95996) Computer simulation of underwater nuclear effects.** Kamegai, M. (Lawrence Livermore National Lab., CA (USA)). 30 Jan 1987. Contract W-7405-ENG-48. 25p. (CONF-870156—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005967.

From Workshop on hydrocode application in ocean environment; Marina del Ray, CA, USA (14 Jan 1987).

We investigated underwater nuclear effects by computer simulations. First, we computed a long distance wave propagation in water by the 1-D LASNEX code by modeling the energy source and the underwater environment. The pressure-distance data were calculated for two quite different yields; pressures range from 300 GPa to 15 MPa. They were found to be in good agreement with Snay's theoretical points and the Wigwam measurements. The computed data also agree with the similarity solution at high pressures and the empirical equation at low pressures. After completion of the 1-D study, we investigated a free surface effect commonly referred to as irregular surface rarefaction by applying two hydrocodes (LASNEX and ALE), linked at the appropriate time. Using these codes, we simulated near-surface explosions for three depths of burst (3 m, 21 m and 66.5 m), which represent the strong, intermediate, and weak surface shocks, respectively.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 24177

23405 **(AD-A—176010/7/XAB) Source depths utilizing broad-band data. Annual technical report, 11 April 1985-10 April 1986.** Sutton, G.H.; Carter, T.A.; Barstow, N. (Rondout Associates, Inc., Stone Ridge, NY (USA)). 11 Apr 1986. 51p. NTIS, PC A04/MF A01.

This report covers the first year's effort of a two-year research project to improve our ability to discriminate between nuclear explosions and earthquakes based on the depth of an event determined from local and regional phases. The approach taken has been to improve phase identification and picking abilities for depth phases pP and sP throughy adaptive filtering to reduce effects of mode conversion and scattering. Three-component polarization methods are applied to broad-band digital data from a set of earthquakes located in the northeastern United States and adjacent Canada. The cleaned-up data are compared with suites of synthetic seismograms for different depths and focal mechanisms obtained using two velocity/attenuation models appropriate for northeastern United States and Canada. This comparison provides a basis for identification of the depth phases and discrimination of other reflected/refracted arrivals in the P wavetrain. Polarization state filtering (following procedures proposed by Samson) is used to emphasize those frequencies exhibiting the desired particle motion within a time window that slides through the P wavetrain. Adaptive orientation of the state filtered data into radial and transverse horizontal components and determination of azimuths and apparent angles of incidence further facilities phase identification and comparison with synthetics. Eight local and regional earthquakes and one quarry blast were selected for study. Polarization filtering reduces much of the P coda and emphasizes discrete portions of the wavetrain as anticipated.

23406 **(SAND—86-2885) Preliminary results of MUNDO high altitude pressure measurements.** Banister, J.R.; Hereford, W.V.; Solomon, O.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005807.

Four high altitude pressure measurement canisters were deployed for the MUNDO event. All canister parachutes deployed and the placement of instruments was quite satisfactory in spite of an unusual wind change. Fouled leak plugs caused the two intermediate pressure transducers to be driven out of range but a new and reasonably successful procedure was developed for recovering the pressure histories of these canisters from acceleration histories. The measurements bridged across from the central radiation cone to the transition region. Pressure levels and pressure histories at outer stations are atypical with the unexpected appearances of shock fronts. Pressure histories were more complicated with peak pressures lower than observed on RUMMY.

23407 **(UCRL—95242-Rev.2) Elements of a system for verifying a Comprehensive Test Ban.** Hannon, W.J. (Lawrence Livermore National Lab., CA (USA)). 6 Mar 1987. Contract W-7405-ENG-48. 33p. (CONF-8609264—1-Rev.2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007094.

From Workshop on global seismic monitoring; Canberra, Australia (23 Sep 1986).

The paper discusses the goals of a monitoring system for a CTB, its functions, the challenges to verification, discrimination techniques, and some recent developments. It is concluded technical, military and political efforts are required to establish and verify test ban treaties which will contribute to stability in the long term. It currently appears there will be a significant number of unidentified events. (ACR)

23408 **Unattended in-country stations for seismic verification.** Stokes, P.A. (Systems Research Dept., Sandia National Lab.). pp 264-274 of Arms control verification: The technologies that make it possible. Tsipis, K.; Hafemeister, D.W.; Janeway, P. Elmsford, NY; Pergamon Books Inc. (1986).

The capabilities and requirements of unmanned seismic stations placed by one signer of a treaty banning underground testing within the boundaries of another for purposes of verification become newly significant in light of the discovery reported in the previous chapter by Evernden and Archambeau. If it is now possible to detect underground nuclear explosions down to the level of a kiloton or so, the only remaining technical questions on the way to a Complete Test Ban Treaty concern the seismic stations, which are described in the following chapter.

23409 **Satellite verification of arms control agreements.** Argo, H.V. (Los Alamos National Lab.). pp 290-308 of Arms control verification: The technologies that make it possible. Tsipis, K.; Hafemeister, D.W.; Janeway, P. Elmsford, NY; Pergamon Books Inc. (1986).

This chapter describes the characteristics of the physical phenomena on which detection of nuclear detonation is based, as well as the instruments designed to implement such detections. The evolution over the years of past instruments into present systems and towards future systems is described and evaluated. The chapter leaves little doubt that our ability to detect nuclear tests above ground has always been adequate and that it is constantly being improved and refined nevertheless.

23410 **Nonlinear and semilinear dynamic poroelasticity with microstructure.** Berryman, J.G.; Thigpen, L. (Lawrence Livermore National Lab., CA). *Journal of the Mechanics and Physics of Solids;* **33**: No. 2, 97-116(1985). Contract W-7405-ENG-48.

Nonlinear equations for wave propagation through dry or fluid-saturated porous elastic media are derived using a variational formulation. The method presented is very similar to the approach of Bedford and Drumheller, including microinertia terms for local density fluctuations of fluid and solid. One major difference is the choice of a Lagrangian (rather than Eulerian) reference frame locked to the solid constituent. This choice of reference frame is preferable for porous solids and also allows direct comparison to Biot's theories of nonlinear and semilinear rheology of porous solids. 17 references.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 23119, 23430, 23457, 23516

23411 (CONF-870128—2) Measurement of high resolution wind profiles with a minisodar. Coulter, R.L.; Martin, T.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007001.

From 6. symposium on meteorological observations and instrumentation; New Orleans, LA, USA (12 Jan 1987).

The minisodar developed at ANL has proven to be a valuable tool in surface and boundary layer investigations, particularly in complex terrain, nocturnal boundary layer, and precipitation conditions. Data from low heights and fine resolution have proven to be accurate and dependable. An increased sampling rate of about a factor of ten over conventional sodars has been realized. It should be noted, however, that due to its limited maximum range, operation with other remote sensors is often desirable. For example, with the computational power available presently, a combination of mini- and conventional sodars could be operated simultaneously with the same operating system with relative ease.

23412 (DOE/ER/60085—H1) Global distribution of total cloud cover and cloud type amounts over land. Warren, S.G.; Hahn, C.J.; London, J.; Chervin, R.M.; Jenne, R.L. (Washington Univ., Seattle (USA). Dept. of Atmospheric Sciences; Colorado Univ., Boulder (USA); National Center for Atmospheric Research, Boulder, CO (USA)). Oct 1986. Contract AI01-82ER60085. 468p. (NCAR-TN/STR—273). NTIS, PC A20. File Number DE87006903.

The atlas describes, for the land areas of the earth, the average total cloud cover and the amounts of each cloud type, and their geographical, diurnal, seasonal, and interannual variations, as well as the average base heights of the low clouds.

23413 (EPRI-EA—5091-Vol.1) Modeling the polluted coastal urban environment: Volume 1, The PBL [planetary boundary level] model: Final report. Bornstein, R.; Pechinger, U.; Miller, R.; Klotz, S.; Street, R. (San Jose State Univ., CA (USA). Dept. of Meteorology; Stanford Univ., CA (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 195p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920282.

The two-dimensional vorticity-mode URBMET planetary boundary-layer model has been extended to three dimensions by use of a second vorticity component and a second stream function. The model is capable of simulating the time-varying distributions of velocity, temperature, and (sub-saturation) moisture in a Boussinesq, hydrostatic, and incompressible flow field. The model consists of a numerical soil layer, and in the atmosphere, both an analytical constant-flux layer and numerical transition layer. Sea breeze flow conditions in the New York City (NYC) area have been simulated utilizing first-order turbulence closure, with surface temperature and moisture predicted from energy and moisture balances. Results reproduced many of the observed features of sea breeze fronts in the NYC area. Predicted meteorological variables were used as input to a three-dimensional Eulerian-grid sulfur-dioxide dispersion model of point and area sources within the NYC area, as described in Volume II of this report. The model was also used to simulate sea breeze flow at an idealized coastline using the Level 2.5 turbulence parameterization of Mellor and Yamada. This formulation involves solution of an additional prognostic differential equations for turbulent kinetic energy. Results indicate that turbulence from the mid-morning unstable land area was advected offshore into the stable marine region for significant distances.

23414 (GKSS—86/E/35) On the simulation of convective structures. Levkov, L.; Eppel, D.; Grassl, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751209.

A parameterization scheme for the simulation of convective clouds is presented. Convection is described by a diagnostic equation providing a height dependent convective velocity inside the cloud. The updraft is started by taking a vertical velocity at cloud base proportional to Deardorff's convective velocity scale. Estimates from Bruemmer et al. (1986) suggest a value of one tenth for the proportionality factor. In addition to conserving rainwater within the solution domain we consider precipitation reaching the ground. For numerical testing the cloud parameterization scheme is incorporated into a three-dimensional hydrostatic mesoscale model (Beniston, 1984). Data from KonTur experiment show qualitative agreement between calculated and observed rainfall rates. With 13 figs.

23415 (Juel-Spez—351) Climatic values measured at the meteorological station of the Kernforschungsanlage Juelich from 1961 to 1985. Bergs, W.; Geiss, H.; Polster, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz). Mar 1986. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751188.

Since 1961 the Kernforschungsanlage Juelich has been disposing of a data base collecting complete meteorological data. The publication abstracted makes them available by way of compiling climatic data and values either derived from the respective annual mean or total values or from the mean values of each month over a period of 25 years, from 1961 to 1985. Moreover, the publication compiles the mean annual values relevant to the period concerned. A tabular survey is given of the maximum and minimum values measured from 1961 to 1985, 25-year mean values, monthly values, annual values of the respective factors observed, individual values per month and year as well as of the frequency distribution of wind direction and wind velocity.

23416 (LA-UR—87-678) A simple theory of cloud spreading at ranges from 1-2000 km. Gifford, F.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-870444—1). NTIS MF A01; 2; GPO Dep. File Number DE87006067.

From 16. international technical meeting on air pollution modelling and its application; Lindau, F.R. Germany (6 Apr 1987).

Examples support the conclusion that cloud or plume spreading in the troposphere proceeds rapidly and rather steadily for times on the order of a day or two and to distances of several hundreds of kilometers. Subsequently, possibly after a transition to the asymptotic rate of relative diffusion, the cloud begins to develop a streaky structure under the influence of the large-scale, enstrophy-cascade range of motions. The GASP spectra indicate that the transition between these two modes of spreading begins at several hundred kilometers ad is well developed by about 1000 km, in terms of spectral wavelength. The cloud streaks and patches elongate rapidly, evidently at the exponential rate, but spread laterally more slowly, at a rate that represents the effects of the conservation of cloud area under large-scale deformation and the lateral diffusion at the asymptotic rate. Although this relative diffusion occurs at a comparatively slow rate, it is very effective in reducing cloud concentrations in combination with the rapid, large-scale cloud stretching by the 2-D, enstrophy-cascade range eddies. The LANL heavy-methane cloud data indicate that the net result is very rapid decay of cloud concentration, apparently at an exponential rate.

23417 (OEFZS—4378) Determination of iodine 129 in environmental samples from Austria by neutron activation analysis. Working methods and results (1984-1985). Karg, V.; Schoenfeld, T. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 26p. (In German). (ST—141/86). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701592.

For various types of samples (thyroids from humans, from game and cows; ground water, snow and air filters) the /sup 129/I-contents, expressed as /sup 129/I//sup 127/I-ratio (R), were determined by neutron activation analysis. The method utilises the neutron induced reactions /sup 129/I(n, γ)/sup 130/I and /sup 127/I(n, 2n)/sup 126/I. Four main steps are involved: 1. Separation of iodine from the sample and conversion to a form suitable for neutron irradiation. 2. Irradiation in a reactor. 3. Chemical processing of the irradiated material, i.e. separation of radio-iodine with addition of carrier. 4. Measurement of activities of /sup 130/I and /sup 126/I with a gammaspectrometer. The /sup 129/I//sup 127/I-ratio (R) is then obtained by comparing with the activities produced in a reference sample (usually with R = 1.0 x 10/sup -8/) which is irradiated simultaneously. Details of the method are presented in the report. R-values between 0.6 x 10/sup -8/ and 39 x 10/sup -8/ were found. The highest values were those of snow and game thyroids. Ground water contained very little /sup 129/I. The results confirm the expectation that /sup 129/I enters the biosphere mainly via air and precipitation.

23418 (PPA-CR—4) Application of environmental Cs-137 techniques to problems of sediment redistribution Sungai Lui Representative Basin, Selangor, Malaysia. Daud bin Mohamad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Oct 1980. 8p. (CONF-8010386—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701455.

From IAEA/RCA project review meeting; Seoul, Korea (13 Oct 1980).

Secondary standard dosimetry laboratory (UPDK), Nuclear Energy Unit, is well equipped with all necessary irradiation facilities and radiation measuring devices. The establishment of the Laboratory is partly aimed at giving calibration services for all kinds of dosemeters, personnel radiation monitoring by using film badges and TLD etc. In running the above services, safe and correct handling procedures of the mentioned facilities and devices are necessary. Furthermore, the accuracy of measurements is of great importance. This report outlined the procedures of handling the equipment, of performing experimental works as well as of getting the mentioned services from UPDK. This report is referred as a guide containing all the standard procedures aiming at a safety operation of radiation and electrical devices and finally to achieve a high degree of dosimetric accuracies.

23419 (UCID—20933) FEM3 dispersion calculations: Evaluation of turbulence submodel. Ermak, D.L.; Chan, S.T. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. 32p. NTIS, PC A03/MF A01. File Number DE87006880.

An overview of FEM3, a three-dimensional computer model designed to simulate the atmospheric dispersion of large heavier-than-air gas releases, was given. The model employs a modified finite element method (Gresho et al., 1984) to solve the time-dependent conservation equations of mass, momentum, energy, and species along with the ideal gas law for the equation of state. Turbulence is treated by using a K-theory submodel. These equations provide a mathematical description of the physics of heavy gas dispersion including gravity spread, the effect of density stratification on turbulent mixing, and ground heating into the cloud and its effects on density stratification and turbulence. In addition, FEM3 can treat flow over variable terrain and around obstructions such as cylinders and cubes. Since it is fully three-dimensional, FEM3 can simulate complicated cloud structures such as the vortices that are typical of dense gas flows, cloud bifurcation that has been observed during heavy gas releases under low windspeed, stable, ambient conditions, and cloud deflection caused by sloping terrain.

23420 (UCRL—15893) Continued contributions to large-eddy simulation. Ohmstede, W.D. (Ohmstede (William D.), Las Cruces, NM (USA); Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 106p. NTIS, PC A06. File Number DE87007328.

The report summarizes work done in support of the large-eddy simulation (LES) project. Particular attention was paid to the bottom boundary conditions and optimum discretization of equations in the vicinity of the bottom boundary. The work was subdivided into four related tasks: (1) LES parameterization and initialization; (2) air/earth interaction; (3) numerical optimization; and (4) analysis and interpretation. (ACR)

23421 Southern Hemisphere temperatures 1851-1985. Jones, P.D. *Climate Monitor;* **14**: No. 5, 132-140(1985). Contract FG02-86ER60397.

This article presents a series of mean monthly temperature anomalies for the Southern Hemisphere land areas. Altogether, the data base totals 610 usable stations between 2.5°s and 62.5°s. Only for Brazil is the coverage poor. The period 1951-1970 is used as a reference period. Monthly grid point anomalies, relative to 1951-1970, were calculated back to 1851; a 5° latitude by 10° longitude grid is used. Hemispheric average estimates are given beginning in 1858. 12 references, 1 figure, 2 tables.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 22153, 22156, 22159, 22160, 22179, 22410, 22411, 22412, 22413, 22414, 22415, 22435, 22436, 22437, 22809, 23080, 23110, 23248, 23249, 23250, 23251, 23252, 23454

23422 (AD-A—175956/2/XAB) Smoke and obscurants; a health and environmental effects data base assessment. A first-order, environmental screening and ranking of Army smokes and obscurants. Report for 1983-1985 on Phase 1. Shinn, J.H.; Martins, S.A.; Cedarwall, P.L.; Gratt, L.B. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. 115p. NTIS, PC A06/MF A01.

An initial environmental screening and ranking is provided for each Army smoke and obscurant depending on smoke type and smoke-generating device. This was done according to the magnitude of the impact area, the characteristic environmental concentration, the relative inhalation toxicity, the relative toxicity when ingested concentration, the relative inhalation toxicity, the relative toxicity when ingested by animals, the aquatic toxicity, the environmental mobility when freshly deposited, and the ultimate mobility and fate in the environment. The major smoke types considered were various forms of white phosphorus, red phosphorus, hexachlorethane-derived smokes (HC), fog-oil (SGF-2), diesel fuel smokes (DF), and some infrared obscuring agents. The results were ranked according to: Device Impact Area and Environmental Concentration; Inhalation Toxicity and Air Concentration Quotient; Oral Toxicity and Ingestion Quotient; Aquatic Toxicity Quotient; Short-Term and Long-Term Mobility in the Environment; and Overall Environmental Importance.

23423 (BNL—39209) Sources of nitrogen oxide pollution in the indoor environment. Kalb, P.D. (Brookhaven National Lab., Upton, NY (USA)). Feb 1986. Contract AC02-76CH00016. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006742.

Nitrogen oxide (NO/sub x/) emissions in indoor environments primarily result from inverted kerosene and gas space heaters, gas-fired ranges and ovens, and tobacco smoking. Major factors that influence NO/sub x/ emissions are discussed and current emission research data are reviewed. Typical source levels are reported (in micrograms/kilojoule) for potential use in regional exposure modeling.

23424 (CONF-861158—8) Why an SO_2 emission tax is an unpopular policy instrument: Simulation results from a general equilibrium model of the Norwegian economy. Hanson, D.A.; Alfsen, K.H. (Argonne National Lab., IL (USA); Central Bureau of Statistics, Oslo (Norway)). 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006963.

From 8. North American International Association of Energy Economists conference: changing world energy economy; Cambridge, MA, USA (19 Nov 1986).

Norway, together with some twenty other countries, signed the Helsinki treaty in July 1985 for the purpose of reducing SO_2 emissions. Hence, it is interesting to analyze the emission reductions that could be achieved using a tax on SO_2 emissions, as well as the indirect impacts on the economy. Simulations of the economic impact of the tax (which effectively increases the cost of using energy) were made using the Multi-Sectoral Growth (MSG) model. Results of the simulations indicated a larger than expected reduction in economic output.

23425 **(CONF-861268—1) Source-receptor relationships and control strategy formulation.** Streets, D.G. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007008.

From Symposium on acid rain: the relationship between sources and receptors; Arlington, VA, USA (3 Dec 1986).

Three types of strategy are discussed: emissions-optimized, in which one seeks to reduce emissions wherever they are greatest; cost-optimized, in which one seeks to reduce emissions wherever it is cheapest to do so; and deposition-optimized, in which one seeks to reduce emissions wherever it will lead to the most cost-effective reduction in deposition at a particular receptor site or set of sites. This third strategy is the one that takes advantage of source-receptor relationships. Almost all of the proposals introduced to Congress in the last five years have been of the emissions-optimized variety. It has been the thesis of several research groups that consideration of cost-optimized and deposition-optimized strategies could offer significant advantages over the "scattershot' emissions-optimized approaches.

23426 **(CONF-861269—1) Climate predictions, regions, and resources.** Cushman, R.M.; Waterhouse, J.C.; Farrell, M.P. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006625.

From 5. US-USSR symposium on comprehensive analysis of the environment; Washington, DC, USA (10 Dec 1986).

The paper discusses the development of methods to refine the predictions of climate change on a regional scale. Emphasis is placed on the development and refinement of analytical methods for multiresource, regional effects analyses. Some questions considered are: What types of regions (possibly, combinations thereof) are optimal for the analyses? What resources are of greatest importance? What cause-and-effect models are most suitable - regression, simulation? What resource interactions and feedbacks need to be considered? How should resource data be managed and aggregated to regional levels?

23427 **(DOE/EIS—0127-Vol.2) Draft environmental impact statement on new energy-efficient homes programs: Assessing indoor air quality options: Volume 2.** (USDOE Bonneville Power Administration, Portland, OR). Feb 1987. 496p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE87007160.

This Volume contains: Appendix A - The New Homes Conservation Resource with five support appendices; Appendix B - Potential Health Effects of Certain Indoor Air pollutants; Appendix C - Indoor Air Quality Mitigation Technologies with six support appendices; and Appendix D - Economic and Social Effects of the Model Conservation Standards. The above appendices, prepared by Pacific Northwest Laboratory (PNL), are included in Volume II to supply key supporting information for the findings presented in Volume I of the EIS.

23428 **(DOE/ER/60444—T1) A review of national and international activities on modeling the effects of increased CO_2 concentrations on the simulation of regional crop production: (A report on linkage between climate and crop models): Progress report.** Decker, W.L.; Achutuni, R. (Missouri Univ., Columbia (USA). Cooperative Inst. for Applied Meteorology). 1 Jan 1987. Contract FG02-86ER60444. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005994.

General circulation models have been used to estimate the probable changes in climate due to increased levels of carbon dioxide. These models, generally, project increases in the mean surface temperatures; but changes in precipitation due to CO_2 enrichment are not as clear. It appears that some process models, which utilize a minimum amount of empiricism, can be adopted for use in studying the impacts of both climate change scenarios and the direct effects of CO_2 fertilization. The CERES-Maize, CERES-Wheat, SORGF, GLYCIM, and SOYGRO are among those classified for this use. There is a great deal of effort being directed toward these developments. A WMO/UNEP/ICSU focus has sponsored at least two European meetings but with only limited success for testing production models. A similar effort has been conducted by the Commission of European Communities. An attempt has been made to modify the CERES models, which have been used in climate studies, for use in simulation of the direct effects. Initial simulations involving this modification, show that doubling CO_2 will increase corn production 12 to 30% at locations in northern Illinois for the four-year period 1982 to 1985. The increase in yield due to higher photosynthesis showed a greater effect than the impact of decreased transpiration.

23429 **(EPRI-CS—5040) Precipitator performance estimation procedure: Final report.** DuBard, J.L.; Dahlin, R.S. (Southern Research Inst., Birmingham, AL (USA). Control Device Research Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 190p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920275.

This report presents a precipitator performance estimation procedure based on a compilation of measured operating parameters of cold-side utility fly ash precipitators. Mathematical correlations of the measured operating parameters are used to develop input data for an existing computer model of electrostatic precipitation. The only site-specific data needed for the estimation procedure consist of core-bore coal and coal ash analyses, values of precipitator mechanical dimensions, and values of gas temperature and gas volume flow. The remaining data can be estimated by methods developed in this report, if measured values are not available. The remaining data consist of the following operating parameters which influence precipitator performance: inlet fly ash mass loading, inlet particle size distribution, fly ash electrical resistivity, and precipitator voltage and current. The estimated values of these data, and confidence limits on the estimated values, are obtained from mathematical correlations of the measured operating parameters. A sensitivity analysis of the computer model is performed to obtain confidence limits on the computed precipitator collection efficiency. The uncertainty in computed collection efficiency, using estimated data, is shown to be comparable to the day-to-day scatter in collection efficiency measurements on site.

23430 **(HMI-B—432) Numerical models for computation of pollutant-dispersion in the atmosphere.** Leder, S.M.; Biesemann-Krueger, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik; Freie Univ. Berlin (Germany, F.R.). Fachbereich Mathematik). Apr 1985. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751221.

The report describes some models which are used to compute the concentration of emitted pollutants in the lower atmosphere. A dispersion model, developed at the University of Hamburg, is considered in more detail and treated with two different numerical methods. The convergence of the methods is investigated and a comparison of numerical results and dispersion experiments carried out at the Nuclear Research Center Karlsruhe is given.

23431 (ORNL—6353, pp 161-165) **Energy and environmental information analysis program.** Oen, C.J.; Dailey, N.S.; Huffstetler, J.K.; Kertesz, M.P.; Owen, P.T.; Pfunderer, H.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Activities within the program are highly varied. Emphases follow problem or project lines, such as conservation, fossil energy, and acid rain, as well as tasks to develop total information systems. A number of program staff work with researchers in other Oak

Ridge National Laboratory divisions or programs in a matrix mode. Subject areas include: applied earth sciences, engineering, environmental effects, waste management, and computer science. Significant new involvements this year are in information system planning and design using relational database concepts, and in microcomputer applications and local area computer networking.

23432 **(PB—87-126025/XAB) Interactive computer model for calculating V-I curves in ESPS (electrostatic precipitators): Version 1.0 (for microcomputers). Model.** Sparks, L.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1986. vp. NTISCP T99.

The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC XT/AT 2000 microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—87-100046.

The two microcomputer programs are written to estimate the performance of electrostatic precipitators (ESPs): the first, to estimate the electrical conditions for round discharge electrodes in the ESP; and the second, a modification of the EPA/SRI ESP model, to estimate the particle collection efficiency of the ESP operating with the electrical conditions predicted by the first program. Both programs, written in the BASIC computer language, are designed for the IBM-PC and compatible computers and the Tandy 2000 computer. The programs require Advanced BASIC and a color-graphics adapter. The models are quite useful and allow rapid assessment of expected ESP performance under a wide variety of conditions. Software description: The program is written in the Basic programming language for implementation on an IBM Tandy, PC, XT, AT 2000, using the PC-DOS (2.0) or higher or the MS-DOS (2.1) or higher operating systems.

23433 **(PB—87-132098/XAB) User's guide for PEM-2: Pollution Episodic Model (version 2). Final report.** Rao, K.S. (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Dec 1986. 235p. NTIS, PC A11/MF A01.

For system on magnetic tape, see PB—86-222361.

The Pollution Episodic Model Version 2 (PEM-2) is an urban-scale model designed to predict short-term average ground-level concentrations and deposition fluxes of one or two gaseous or particulate pollutants at multiple receptors. The two pollutants may be non-reactive, or chemically-coupled through a first-order chemical transformation. Up to 300 isolated point sources and 50 distributed area sources may be considered in the calculations. Concentration and deposition flux estimates are made using hourly mean meteorological data. Up to a maximum of 24 hourly scenarios of meteorology may be included in an averaging period. The concentration algorithms used in PEM-2 are specially developed to account for the effects of dry deposition, sedimentation, and first-order chemical transformation. The Gaussian plume-type algorithms for point sources are derived from analytical solutions of a gradient-transfer model. The User's Guide lists the concentration algorithms and computational techniques used in the PEM-2 program, and describes the input/output parameters, optional features, capabilities, and limitations of the model. Modifications to the previous version of the model are outlined. The information in the report is directed to the model user and the programmer.

23434 **(PB—87-136941/XAB) Fire and smoke: understanding the hazards. Final report, January 1985-August 1986.** (National Research Council, Washington, DC (USA). Commission on Life Sciences). 1986. 169p. NTIS, PC A08/MF A01.

State of the art of combustion-product toxicity testing and fire-hazard assessment are reviewed. The report discusses recent fire-death trends in the light of current concepts of modern fire hazards. Also considered are the relationship between the physiologic and behavioral end points currently used in combustion-product toxicity test systems and the performance capabilities of humans exposed to fire products. The use of chemical tests of smoke toxic potency is discussed; the use of screening tests or of toxicity tests as screening devices is also discussed. Guidelines for the use of fire-hazard assessment are included.

23435 **(PB—87-137873/XAB) Mathematical model for engineering the venting of volatile groundwater contaminants. Final report on Phase 1, 15 February-31 July 1984.** Montgomery, R.E.; Sheller, M.; Wilson, D. (Texas Research Inst., Inc., Austin (USA)). Nov 1984. 83p. (REPT—84141F:REM). NTIS, PC A05/MF A01.

A mathematical model was developed for predicting the outcome of the forced-venting method for controlling hazardous vapors escaping from underground spills. Equations for predicting concentration profiles were derived from the fundamental laws governing the isothermal flow and dispersion of multicomponent, miscible, compressible fluids in a porous medium. Transformations were developed to remove nonlinearities in the differential equations of the model. Concentration profiles were found to be more sensitive to the dispersion coefficient than to porosity or permeability for the flow rates examined. A comparison of the model profiles with laboratory measurements indicated that realistic predictions are feasible. The model developed in the research effort provides a basis for further development of three-dimensional computer codes for engineering cost-effective venting designs.

23436 **(PB—87-139556/XAB) Impact of background sources on dust exposure of bag-machine operator. Information Circular/1986.** Cecala, A.B.; Thimons, E.D. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 18p. (BM-IC—9089). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600121.

The Bureau of Mines has recorded a number of different background dust sources that significantly contaminate the air breathed by bag-machine operators. These background sources, observed at five different plants over the past two years, can expose bag-machine operators to more significant dust concentrations than the filling process itself. To keep bag-operator exposure within acceptable dust levels established by the Mine Safety and Health Administration, U.S. Department of Labor, the significance of these background sources must be realized, and the sources must be identified and controlled. The purpose of this work is to identify common background dust sources and show the significant effects that they have on the bag operator's overall dust exposure.

23437 **(PB—87-140133/XAB) Iowa air quality report, 1985.** (Iowa Dept. of Natural Resources, Des Moines (USA). Environmental Protection Div.). Nov 1986. 131p. NTIS, PC A07/MF A01.

Iowa's air monitoring data from 1957 to 1985 are compiled in the report for six pollutants monitored in the State: suspended particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The data are presented in tabular form for each pollutant. Additional sections discussing the pollutants and pollutant sources, the air-monitoring network, and the analysis of data and trends are included.

23438 **(PB—87-140919/XAB) Responses of forests to atmospheric deposition. National research plan for the Forest response program. User's guide.** Carey, A.; Janetos, A.C.; Blair, R. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Dec 1986. 108p. (EPA—600/3-86/066). NTIS, PC A06/MF A01.

This document presents the national research plan for the Forest Response Program. The introduction provides an overview, a statement of the program objective, and a brief description of the program's organizational structure. A Program Foundations section forms the heart of the research plan; it discusses the scientific approaches that will be used to reach the program objective. Program Implementation contains the priorities and research approach used by each component of the program and outlines how planned research relates to the program objective. Program Management discusses the role of national program management and procedures for the operation of the program. Major Products describes the tangible outputs from the program.

23439 (PB—87-140950/XAB) Comprehensive experimental design plan to relate pollutant sources to acidic deposition. Final report. McNaughton, D.J.; Bowne, N.E.; Stewart, D.A.; Moore, G.E.; Schwartz, S.E. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Dec 1986. 205p. NTIS, PC A10/MF A01.

Because verifiable numerical models that incorporate all processes determining the dispersion, transformations, and deposition of emitted pollutants associated with acidic deposition from the atmosphere are only now under development, it was deemed worthwhile to determine whether other methods might be available to empirically relate acidic deposition to precursor emissions. An indirect experimental plan, named the combined experimental approach, was developed. The approach consists of three major components: long-range tracer experiments; short-range experiments, including reactive tracers, local deposition experiments, and local source modulation; and routine monitoring of aerometric parameters. Analyses of data would provide estimates of source contributions to deposition at receptor sites. The collected data would also be used for developing and testing upgraded regional models and model components. The report describes the workshop used to develop the general experimental design and the follow-up analyses of the various components. Some of the design sections describe experiments that will yield data for evaluation of acid-deposition models. Finally, the costs of the various experimental efforts are described.

23440 (PB—87-141461/XAB) Stability of parts-per-million organic cylinder gases and results of source test analysis audits: Status Report 8. Howe, G.B.; Jayanty, R.K.M.; Decker, C.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jan 1987. 93p. NTIS, PC A05/MF A01.

A repository of 45 gaseous compounds including hydrocarbons, halocarbons, and sulfur species was established under contract with the U.S. Environmental Protection Agency (USEPA). The main objectives of this on-going project are (1) to provide gas mixtures to EPA, state/local agencies, or their contractors, as performance audits to assess the accuracy of source-emission measurements in certain organic chemical manufacturing industries, (2) to corroborate the vendor's certified analysis of the gas mixtures by in-house analysis, (3) to determine the stability of the gas mixtures with time by in-house analysis, and (4) to explore the feasibility of new audit materials as requested by EPA.

23441 (PB—87-141479/XAB) Stochastic prediction of dispersive-contaminant transport. Final report, 1 September 1983-30 April 1986. Vomvoris, E.G.; Gelhar, L.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Civil Engineering). Dec 1986. 104p. NTIS, PC A06/MF A01.

The objective of the research agreement was to develop mathematical models to quantify the concentration variability observed in field measurements of concentration plumes. The concentration variability is attributed mainly to spatial heterogeneity of the hydraulic-conductivity field. Since there is limited information about actual distributions of hydraulic conductivity in a given site, the log-hydraulic conductivity is modeled as a three-dimensional anisotropic stationary random process. It is shown that the concentration variance, which measures the intensity of the variations, is proportional to the mean concentration gradient and to the variance and correlation scales of the log-hydraulic conductivity; it is inversely proportional to the local dispersivity values. Analysis of a portion of the data from the Canadian Forces Base, Borden, Ontario, shows the applicability of the developed results in field situations. Simple analytical examples demonstrate the way to use the results in a predictive context.

23442 (PB—87-145702/XAB) Gray-iron foundry industry particulate emissions: source category report. Final report, June 1983-August 1986. Jeffrey, J.; Fitzgerald, J.; Wolf, P. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Dec 1986. 85p. NTIS, PC A05/MF A01.

This report gives results of a study to develop particulate emission factors based on cutoff size for inhalable particles for the gray-iron foundry industry. After a review of available information characterizing particulate emissions from gray iron foundries, the data are summarized and rated in terms of reliability. Size-specific emission factors were developed from these data for the major processes used in the manufacture of gray iron. A detailed process description is presented with emphasis on factors affecting the generation of emissions. A replacement for Section 7.10 (Gray Iron Foundries) of EPA report AP-42, A Compilation of Air Pollutant Emissions Factors, was prepared, containing the size-specific emission factors developed during the program.

23443 (RHO-CP-PL—45-P) PUREX and UO_3 plant nitrogen oxide monitoring plan. Pavlina, R.S. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1986. Contract AC06-77RL01030. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006956.

The emission of nitrogen oxides (NO/sub x/) from PUREX and UO_3 Plants is subject to limitations set by the US Environmental Protection Agency, Region X (EPA). The Prevention of Significant Deterioration permit number PSD-X80-14, issued by the EPA for PUREX and UO_3 Plants, describes these limits. This document outlines Rockwell Hanford Operations' plan for monitoring the PUREX and UO_3 Plants' NO/sub x/ emissions and exhaust through the 291-A-1 and 296-U-4 stacks. Five DuPont 461 photometric analyzers continuously monitor the NO/sub x/ concentrations in the 291-A-1 stack and at three other points in the process, while another analyzer monitors the 296-U-4 stack. A KURZ EVA 4000 Electronic Velocity Array continuously monitors the airflow through the 291-A-1 stack, and an annubar continuously monitors the airflow through the 296-U-4 stack.

23444 (UCID—20988) Tooele Army Depot air quality monitoring systems user's guide: System description, standard operating procedures, and installation report. Surano, K. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87007354.

This document is an overview of Monitor Labs air-quality monitoring systems installed at Tooele Army Depot during 1986. This report is written from a user's standpoint and assumes that the reader has some familiarity with air-quality systems. This document includes background information on the project and descriptions of the systems and all components; makes suggestions for daily, weekly, and quarterly standard operating procedures; details the installation and tests performed by LLNL/Monitor Labs personnel in bringing the systems on-line; gives the current status of the systems; and provides suggestions for future modifications and/or additions.

23445 (UCRL—15875) The environmental fate of phosphates, chlorides, and organic residuals from combusted military smoke materials: Final report. Leitner, P. (Saint Mary's Coll. of California, Moraga (USA). Dept. of Biology; Lawrence Livermore National Lab., CA (USA)). 15 Jul 1986. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006725.

This report summarizes the results and conclusions of data base assessment studies carried out on the environmental fate of residuals from combusted military smoke materials. The work described is organized as follows: (1) identification of residuals; (2) environmental fate and transport; (3) estimation of toxicities; (4) biota at test facilities; and (5) outline of a short course on preparation of environmental assessment documents.

23446 (UCRL—15876) Data collection and presentation procedures for the US Army's Chemical Hazard Assessment Warning System (CHAWS): For Tooele Army Depot South, Utah. Merry, M.H. (Merry Weather Services, San Francisco, CA (USA); Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006726.

This report describes the basic procedures and references more detailed documents for the operation of meteorological and air quality sensing instrumentation, data depiction and analysis systems for an incinerator pilot plant located at the Tooele Army Depot site near Salt Lake City, Utah. It discusses the site topography and climatology, sensor configuration, calibration, quality assurance and data reporting procedures for the monitoring system

and demonstrates their compliance with applicable environmental regulations of United States Federal Government and the State of Utah.

23447 **Kinetics of hydrogen peroxide—sulfur(IV) reaction in rainwater collected at a northeastern U.S. Site.** Lee, Y.; Shen, J.; Klotz, P.J.; Schwartz, S.E.; Newman, L. (Environmental Chemistry Division, Department of Applied Science, Brookhaven National Laboratory, Upton, New York). *Journal of Geophysical Research;* **91**: No. D12, 13264-13274(20 Nov 1986).

The kinetics of the reaction of dissolved S(IV) with H_2O_2 was studied in freshly collected precipitation samples in order to examine whether there exist any important influences on this reaction from trace constituents present in natural atmospheric liquid water, that is, rainwater and snowmelt. The kinetic study was carried out on over 300 freshly collected precipitation samples obtained at Brookhaven National Laboratory, Long Island, New York, during the period from October 1983 to September 1985. The second-order rate constant k/sup (2)/, defined as -d[H_2O_2]/dt = k/sup (2)/[H_2O_2][S(IV)], which was determined using the precipitation samples covering pH range 3.3—5.6, was found to be linearly dependent on H^+ concentration, conforming to results previously obtained with purified water. The observed scatter in rate constant (+- 30%, standard deviation) is comparable to interlaboratory scatter observed for purified water; the average rate constant is 15% less than values obtained in our laboratory using purified water at the same pH and ionic strength. The scatter and the systematic bias of the data were examined in terms of experimental techniques employed as well as chemical composition of the samples. Sample scatter is attributed in large part to uncertainty in measured pH. The difference in the average rate constant is small compared to the large scatter exhibited by the data. Causes of the negative bias were not clearly identified, but pH uncertainty, ionic strength, and the presence of formaldehyde were ruled out.

23448 **A comparison of a multilayer regional-scale acid rain assessment model (MLRAPT) with a single-layer assessment model, RAPT.** Davis, W.E.; Glantz, C.S. (Pacific Northwest Lab., Richland, WA, USA). *Water, Air, and Soil Pollution;* **30**: No. 3-4, 857-866(Oct 1986). (CONF-850944—). Contract AC06-76RL01830.

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

This study, which is part of the 1985 Assessment on Current Damages of Acid Deposition, examines uncertainty due to treating transport processes using a single-layer model compared to a multilayer model. The Multilayer Regional Air Pollutant Transport Model, MLRAPT, was run in both modes, single layer and multilayer, using 224 sources during a 22-day period in July 1978 for the northeastern United States. Comparison between the two modes indicated that the average air concentrations were highly correlated (a correlation coefficient of 0.98). However, for wet deposition of SO/sub 4//sup =/, a correlation coefficient of 0.55 between the two predicted wet deposition fields was obtained. Results of the comparison of the two modes with the observed air concentration fields and with a limited comparison of observed wet deposition indicate that caution should be used when interpreting results of a single-layer model to develop source/receptor relationships. 8 refs.

23449 **Application of trajectory analysis to the assessment of local and long-range contributions to acidic deposition.** De Pena, R.G.; Rolph, G.D.; Takacs, J.F.; Holian, J.O. (Pennsylvania State Univ., University Park, USA). *Water, Air, and Soil Pollution;* **30**: No. 3-4, 885-896(Oct 1986). (CONF-850944—).

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

Two methods of back trajectories have been applied for 14 precipitation events. One method consisted of a combination of isentropic and constant level trajectories. The second method consisted only of the constant level trajectory. For each method a long range and a local contribution to the chemistry of the precipitation was calculated. The long range contribution was calculated by taking into account the SO/sub 2/ and NO/sub x/ emissions in the areas of the mixed layers traversed by the trajectories, the diffusion, and the dry and wet depositions along the trajectories path. For the local contribution, local emissions and the dry deposition were taken into account. From these contributions expected values of sulfate and nitrate in the precipitation were calculated and these values compared with the observed ones. Results indicate that: the isentropic-constant level model is much better in estimating the measured concentrations of sulfate and nitrate in precipitation than the constant level mode, and the long range transport of precursors contributed more to the total concentration than the local emissions. 10 refs.

23450 **Estimation of source-receptor matrices for deposition of NO/sub x/-N.** Shannon, J.D.; Lesht, B.M. (Argonne National Lab., IL, USA). *Water, Air, and Soil Pollution;* **30**: No. 3-4, 815-824(Oct 1986). (CONF-850944—).

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

The contributions of the anthropogenic sources of NO/sub x/ from various combinations of contiguous U.S. states or Canadian provinces to integrated deposition across selected states or provinces are estimated with the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model. The model assumes linearity between emissions and deposition, and uses the same parameterization methods, although with different rates, as in simulations of transport and deposition of SO/sub x/. Vertical distributions of emissions for the two classes of pollutants are substantially different in the gridded inventories used in simulations, with a weighted mean effective emission height of 160 m for NO/sub x/ and 310 m for SO/sub x/. This might be expected to lead to an effective transport distance before deposition shorter for NO/sub x/ than for SO/sub x/. However, the calculated fraction of NO/sub x/ emissions deposited within the contiguous United States and Canada south of 60 deg N (57%) is not greatly different from the fraction calculated for SO/sub x/ emissions (54%). This suggests that there may be compensating factors in the horizontal distribution of NO/sub x/ emissions, and in the lower dry deposition velocities for NO/NO/sub 2/ than for SO/sub 2/ in ASTRAP. 12 refs.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 22499, 22520, 22559, 23430, 23466, 23491

23451 **(CONF-860735—1) Measurement of the $^{129}I/^{131}I$ ratio in Chernobyl fallout.** Kutschera, W.; Fink, D.; Paul, M.; Hollos, G.; Kaufman, A. (Technische Univ. Muenchen, Garching (Germany, F.R.). Physikdepartment; Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics; Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics; Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotopes). 1986. Contract W-31109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004990.

From Adriatico research conference on environmental physics: the physics of aerosols; Miramare, Trieste, Italy (21 Jul 1986).

Rainwater collected in the Munich area approximately one week after the Chernobyl reactor accident was investigated for its content of the radioisotopes ^{129}I (T/sub 1/2/ = 1.6 x 10^7 y) and ^{131}I (T/sub 1/2/ = 8.04 d). For the time of release, an isotopic ratio of $^{129}I/^{131}I$ = 19 +- 5 was found. This value was obtained from a gamma-ray activity measurement of ^{131}I with a GE detector and a concentration measurement of ^{129}I with accelerator mass spectrometry. From the measured ratio an operating time of the reactor prior to the accident in the vicinity of two years can be estimated, which is in fair agreement with estimates from other long-lived to short-lived radioisotope ratios in the Chernobyl fallout. Some measurements of ^{131}I activity in thyroids of persons living in the Munich area is also reported.

23452 **(DEMO—83/21G) Study on /sup 226/Ra concentrations in the CFP plant areas and on the radioactivity of lignites and cements containing fly ash.** Danali-Cotsaki, S. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1983. 34p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701499.

Local sampling networks have been installed in the vicinity of coalfired power plants in order to study the radioactive contami-

nation of the environment due to escaped fly ash. Experimental measurements and theoretical calculations have been performed taking into account different meteorological conditions (atmospheric stability, air velocity, etc.) and different characteristics of the power stations (stack diameter, gases velocity) in order to examine the magnitude X/Q in relation to the distance from the power station. Qualitative and quantitative determinations of the radioactivity of lignites and of their ashes have been performed for different areas. Cement samples containing pulverised fly ash as an additive have also been examined.

23453 **(DEMO—84/7G) Investigation of the concentrations of radon-222 and its daughter products in Loutraki spas (Peloponnese, Greece).** Kritidis, P.; Angelou, P. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jul 1984. 27p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701502.

An express variant of the three-interval total alpha-counting filter method being suitable for the determination of elevated concentrations of /sup 222/Rn decay products in air of increased humidity is described. The method has been used for the determination of radon daughters in air in the major radon spas of Loutraki. Concentrations of /sup 222/Rn and /sup 226/Ra in spa water have been determined as well. Annual effective dose equivalents for the personnel and the patients have been estimated. The need of certain radiation protection measures is pointed out.

23454 **(DOE/BP/18690—3) Residential indoor air pollutants.** Wilfert, G.L.; Young, J.K.; Buck, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87006185.

A growing concern about housing is the type, amount and health effects of residential indoor air pollution. In recent years, considerable research has been conducted in an effort to understand the airborne pollutants present in residential indoor air, their sources, their concentration levels, their risks to health, and what can be done to eliminate or mitigate pollution levels. This report focuses on the first three of these: pollutants, sources, and concentration levels. Health risks of key pollutants and mitigation strategies to control pollutant levels are the topics of separate reports. The report reflects current information available through the fall of 1985.

23455 **(EML—458) The High Altitude Sampling Program: Radioactivity in the stratosphere: Final report.** Leifer, R.; Juzdan, Z.R. (USDOE Environmental Measurements Lab., New York). Dec 1986. 65p. NTIS, PC A04. File Number DE87006310.

Radioactivity data are presented from Project Airstream (aircraft) for the year 1983 and for Project Ashcan (balloon) for the years 1982 and 1984. Due to budgetary constraints both Projects Airstream and Ashcan have been terminated. This will be the final report containing radioactivity data collected during projects airstream and ashcan. Included are gross gamma, gamma spectral and radiochemical analyses of filter samples. Quality control samples submitted along with the air filter samples were analyzed and the results are presented. Low activity on many of the filters precludes the estimation of the stratospheric inventories of /sup 239,240/Pu and ^{90}Sr. Based on data with count errors <20%, the mean Northern Hemisphere stratospheric ^{90}Sr and /sup 239,240/Pu concentration for November 1983 was 0.2 +- 0.1 and 0.009 +- 0.006 Bq/1000 scm, respectively.

23456 (IA—1421, pp 175-176) **Gamma radiation measurements in Israel.** Ben-Shachar, B.; Laichter, Y.; German, U.; Weiser, G. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23457 **(INIS-mf—10336) Advanced dispersion models for incident and accident analyses.** Massmeyer, K.; Martens, R.; Pfeffer, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 25p. (In German). (CONF-8611107—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751203.

From 10. GRS expert's meeting on results of new safety analyses; Koeln, F.R. Germany (12 Nov 1986).

The paper gives a short overview concerning the scope of modelling atmospheric dispersion. The most important factors on atmospheric transport processes are summarized. Basic principles of different modelling strategies for the so-called turbulent transport and the advective part of the dispersion process are introduced. The range of application of those models is discussed under the constraints of model physics and economy of calculation. Bearing in mind the wide range of application of atmospheric transport models, no universal computer code exists. A code system should be installed which allows a coupling of different conceptional approaches. Aided by this system an improved estimation of pollutant diffusion from near to far field regions and under short as well as long period release conditions is strived for. Future work in atmospheric dispersion modelling should cover further model validation and improvement of parameterization schemes, both with respect to complex meteorological and topographical conditions.

23458 **(INIS-mf—10530) Reactor accident at Chernobyl, U.S.S.R. Radiation measurements in Denmark.** (Statens Inst. foer Folkhaelsan, Stockholm (Sweden)). 4 May 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750671.

Also published in Danish.

This report gives the results of radiation measurements in Denmark following the accident in the nuclear power plant at Chernobyl, U.S.S.R. The results of the measurements as of 3 May show that the effect of the accident on Danish territory is comparable to 2 weeks of natural background radiation. The report has been prepared on behalf of a coordinating committee established by Danish authorities after the accident. The coordinating committee is chaired by the National Agency of Environmental Protection and consists of representatives from the National Board of Health, the National Food Agency, Risoe National Laboratory, the Civil Defense, the Meteorological Institute and the Ministry of Foreign Affairs. The report measurements were performed by the National Institute of Radiation Hygiene (part of the National Board of Health) and by Risoe National Laboratory.

23459 **(INIS-mf—10531) Reactor accident at Chernobyl, U.S.S.R. Radiation measurements in Denmark. 2. report.** (Statens Inst. foer Folkhaelsan, Stockholm (Sweden)). 11 May 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750672.

Also published in Danish.

In continuation of the reporting of 4 May 1986 this report summarizes the radioactivity measurements made during the second week after the accident. The data have been collated by the Inspectorate of Nuclear Installations from measurements made by Risoe National Laboratory and the National Institute of Radiation Hygiene. Additional fall-out has by the prevailing meteorological conditions been brought to the country, partly in connection with heavy rain, and as of 10 May the total radiation impact (including future radiation exposures resulting from the Chernobyl accident) is estimated to correspond to approximately one month of natural background radiation.

23460 **(INIS-mf—10532) Reactor accident at Chernobyl, U.S.S.R. Radiation measurements in Denmark. 3. report.** (Statens Inst. foer Folkhaelsan, Stockholm (Sweden)). 28 May 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750673.

Also published in Danish.

In continuation of the reporting of 4 May and 11 May 1986 this report summarizes the radioactivity measurements made during the third and fourth week after the accident at Chernobyl. The data have been collated by the Inspectorate of Nuclear Installations from measurements made by Risoe National Laboratory and the National Institute of Radiation Hygiene. The radioactivity remaining in the air after the first two weeks shows daily variations at low levels without significant contribution to the fall out levels on the ground surfaces. The ground contamination shows a decreasing trend according to radioactive decay and for the plants also according to natural cleaning mechanisms. The radioactive data from the third and fourth week after the accident confirm the previous esti-

mate that the total radiation impact on the Danish area from the accident, including future radiation exposures from the contamination experienced up to now, corresponds at most to approximately one month of natural background radiation. For the time to come the measuring programme and data reporting arrangements will be reorganized with a view to the future long term follow-up of the situation. Thus, this report is expected to be the last in the series of ad hoc reports for prompt dissemination of data on the Danish radioactivity measurements.

23461 **(INIS-mf—10537) Radioactive fallout over Norway after the reactor accident in USSR.** (Helsedirektoratet, Oslo (Norway)). 20 Jun 1986. 22p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750692.

In cooperation with the National Institute for Radiation Hygiene and Institute for Energy Technology, the Directorate of Public Health has published measurements and assessments of the radiological quality of the environment in Norway. For total cesium activity concentration, action levels of 370 Bq/kg and 600 Bq/kg have been laid down for milk/infant food and remaining foodstuffs, respectively. Ground levels of total cesium are in general exceeding 50 kBq/m/sup 2/ in central areas of the country, with local levels reaching 200 kBq/m/sup 2/. For big game the action level is clearly exceeded in the highly contaminated regions. Values up to 24 kBq/kg in reindeer meat are reported. However, no meat with an activity concentration exceeding the action level will be marketed. During the first month following the accident, a major contribution to the total dose has been made by /sup 131/I. Due to short physical half-life, the relative importance is now considered low. The dose contribution during the first month is estimated to 0.04 mSv per person (average) with a maximum of 0.4 mSv. The total individual dose for 1986 from external irradiation is estimated to three times this value, i.e. 0.1 mSv (average), with a maximum of about 1 mSv. The individual doses due to inhaled activity are estimated to 0.01 mSv (average), with a possible maximum of about 0.06 mSv for small children. Doses due to ingestion are at present difficult to estimate. The annual dose will be dominated by /sup 137/Cs and /sup 134/Cs. Experiences from nuclear explosions in the atmosphere during the 1969s and present fallout measurements, seem to justify that the average individual dose over the next 50 years will be in the region of 1 mSv. This year's dose-contribution will probably be of the order of 0.1 mSv.

23462 (INIS-mf—10589, pp 98-99) **Investigation of gamma radionuclide concentration in surface air.** Beseova, G. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23463 **(INP—1171/PL) Influence of sealants of /sup 222/Rn emanation rate from building materials.** Morawska, L. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701575.

Results of measurements of influence of sealants on /sup 222/Rn emanation rate are presented. The measurements were performed with the aid of a special apparatus for measuring concentration of radon isotopes. In this apparatus, working in a closed circulation system, measurements are performed with the aid of an electrostatic precipitator and semiconductor detector.

23464 **(SIS—1986:7) Radon in buildings in Hedmark county.** Stranden, E.; Kolstad, A.K.; Lind, B. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 22p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750696.

Alum shale is known to contain enhanced levels of radium, and it may thus be a source of enhanced indoor radon concentrations. In this report studies of the radiological impact of the alum shale in an area in southern Norway rich in alum shale is summarized. Measurements of the activity concentration of soil and shale radon exhalation from the ground and from geological samples are reported together with measurements of indoor radon concentrations in 165 house. In 48 of the houses the radon concentration exceeded 400 Bq/m/sup 3/, and the highest concentartion (mean value for a house) was 5300 Bq/m/sup 3/. Radon exhalation measurements from the ground suggest that alum shale areas generally should be classified as high radon risk areas.

23465 **(STUK-A—51) Influence of source type and air exchange on variations of indoor radon concentration.** Arvela, H.; Winqvist, K. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Apr 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750677.

The model relates radon concentration to source strength and its variations, air exchange rate and meteorological factors. Two types of sources have been studied. The pressure difference dependent source is made up of radon transported with soil pore air and driven by pressure difference due to the stack effect. The constant source is made up of radon transported by diffusion from building materials or from soil. The air exchange rate depends exponentially on indoor-outdoor temperature difference and linearly on wind speed. These two inputs have been summed in quadrature. In a house with a constant source radon concentration decreases when the air exchange rate increases due to the increasing temperature difference, whereas the pressure difference dependent source causes an increasing concentration. This is due to the fact that the effect of the source strength increase is stronger than the decreasing effect of air exchange on concentration. The winter-summer concentration ratio depends on the combination of the two types of source. A pure pressure dependent source leads to the winter-summer ratio of 2-3.5 (winter -5 deg C, summer +15 deg C, wind speed 3 m/s). A strong contribution of a constant source is needed to cause a summer concentration higher than the winter concentration. The model is in agreement with the winter-summer concentration ratios measured. This ratio increases with the increasing winter concentration. The measured ratio was near 1.0 for houses with winter concentration of 200 Bq m"3 or less and near 2.0 with concentration of 1000 Bq m"3. In a house with a constant source, the diurnal maximum occurs in the afternoon, while in houses with a pressure difference dependent source the time of maximum is early in the morning.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 23495

5006 Regulations

REFER ALSO TO CITATION(S) 22155, 22175, 22197, 22662

23466 **(DOE/EIS—0127-Vol.1) Draft environmental impact statement on new energy-efficient homes programs: Assessing indoor air quality options: Volume 1.** (USDOE Bonneville Power Administration, Portland, OR). Feb 1987. 317p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87007158.

BPA has underway marketing and incentive programs to encourage the construction of new energy-efficient homes that comply with Model Conservation Standards (MCS) developed by the Northwest Power Planning Council. These homes are designed to have lower infiltration rates than current building practices provide, which is likely to contribute to increased levels of indoor air pollutants, and may adversely affect the health of occupants. BPA's current and past new homes programs maintained ventilation rates comparable to those found in current practice homes by requiring balanced mechanical ventilation. BPA now proposes to give builders and consumers more flexibility by increasing the options for protecting indoor air quality in its new homes programs. This proposal is the impetus for this Environmental Impact Statement (EIS), which was prepared for BPA by Pacific Northwest Laboratory. BPA is preparing this EIS to assess whether techniques such as dehumidifiers and air cleaners, pollutant source control, and mechanical ventilation with various control options maintain indoor air quality comparable to that found in homes built using current practices. Although many pollutants are potentially of great concern, our analysis concentrates on radon and formaldehyde. It is based on

measured concentrations of these pollutants and measured ventilation rates, in both current practice and energy-efficient homes. Ventilation was measured using fan pressurization tests, which measure only air leakage, and perfluorocarbon tracer gas (PFT) tests, which account for ventilation from mechanical devices and occupant behavior in addition to air leakage. We used these data to estimate pollutant concentrations and lifetime cancer rates under four alternative actions. Under all of the alternatives, radon had a much greater effect than formaldehyde.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 23621

23467 **(CONF-8510249—Vol.1) Nineteenth international symposium on remote sensing of environment: Proceedings: Volume 1.** (Environmental Research Inst. of Michigan, Ann Arbor (USA)). 1985. Contract FG02-85ER60370. 551p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87006268.

From 19. international symposium on remote sensing of environment; Ann Arbor, MI, USA (21 Oct 1985).

These Proceedings contain papers documenting current activities in the field of remote sensing. Presentations include those concerned with data collection, processing and analysis hardware and methodology, as well as the utilization of this technology in numerous applications for monitoring and managing the earth's resources and man's global environment. Ground-based, airborne and spaceborne sensor systems and botb manual and machine-assisted data analysis and interpretation are included. Separate abstracts have been prepared for individual papers.

23468 **(CONF-8510249—Vol.2) Nineteenth international symposium on remote sensing of environment: Proceedings: Volume 2.** (Environmental Research Inst. of Michigan, Ann Arbor (USA)). 1985. Contract FG02-85ER60370. 564p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87006269.

From 19. international symposium on remote sensing of environment; Ann Arbor, MI, USA (21 Oct 1985).

These Proceedings contain papers documenting current activities in the field of remote sensing. Presentations include those concerned with data collection, processing and analysis hardware and methodology, as well as the utilization of this technology in numerous applications for monitoring and managing the earth's resources and man's global environment. Ground-based, airborne and spaceborne sensor systems and both manual and machine-assisted data analysis and interpretation are included. Separate abstracts have been prepared for individual papers.

23469 **Wintering bats of the upper Snake River Plain: occurrence in lava-tube caves.** Genter, D.L. (Univ. of Montana, Missoula). *Great Basin Naturalist;* **46**: No. 2, 241-245(30 Apr 1986).

Distribution and habitat selection of hibernating bats at the Idaho National Engineering Laboratory (INEL) and adjacent area are reported. Exploration of over 30 lava-tube caves revealed that two species, Myotis leibii and Plecotus townsendii, hibernate in the upper Snake River Plain. Five species, M. lucifugus, M. evotis, Eptesicus fuscus, Lasionycteris noctivagans, and Lasiurus cinereus are considered migratory. Myotis leibii and P. townsendii hibernate throughout much of the area, occasionally in mixed-species groups. Myotis leibii uses the dark and protected regions of the cave, usually wedged into tiny pockets and crevices near or at the highest portion of the ceiling. Individuals of P. townsendii may be found at any height or depth in the cave. Temperature appears to be primary limiting factor in habitat selection. Myotis leibii was found in significantly cooler air temperatures than P. townsendii. Neither species tolerated continuous temperatures below 1.5 C. Relative humidity does not seem to be a significant factor in the distribution or habitat selection of the two species in lava-tube caves. 18 references, 1 figure, 1 table.

23470 **Energy and protein content of coyote prey in southeastern Idaho.** MacCracken, J.G.; Hansen, R.M. (Colorado State Univ., Fort Collins). *Great Basin Naturalist;* **46**: No. 2, 274-275(30 Apr 1986).

Gross energy, digestible energy, crude protein, and digestible crude protein were estimated for two leporids and five rodents that were the primary prey of coyotes (Canis latrans) in southeastern Idaho. Digestible protein estimates differed (38%-54%) more than digestible energy (3.5-4.4 kcal), in the prey examined. 15 references, 1 table.

23471 **Coleoptera of the Idaho National Engineering Laboratory: an annotated checklist.** Stafford, M.P.; Barr, W.F.; Johnson, J.B. (Univ. of Idaho, Moscow). *Great Basin Naturalist;* **46**: No. 2, 287-293(30 Apr 1986).

An insect survey was conducted on the Idaho National Engineering Laboratory during the summers of 1981-1983. This site is on the Snake River Plains in southeastern Idaho. Presented here is an annotated checklist of the Coleoptera collected. Successful collecting methods, dates of adult occurrence, and relative abundance are given for each species. Relevant biological information is also presented for some species.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 23428, 23431, 23438, 23518, 23519, 23520, 23525

23472 **(AD-A—175862/2/XAB) Remediation of PCB (polychlorinated biphenyl) contamination, Woodbridge Research Facility, Woodbridge, Virginia. Final report, 27 September 1984-30 April 1986.** Foulke, M.B.; Starnes, M.E. (Weston (Roy F.), Inc., Decatur, GA (USA)). 1 May 1986. 76p. NTIS, PC A05/MF A01.

This report presents the results of the remediation of polychlorinated biphenyl (PCB) contamination at the Woodbridge Research Facility, Woodbridge, Virginia. The report details site-specific activities performed during the sampling, analysis, and subsequent removal and disposal of PCB-contaminated soil and debris at the facility. The report provides the analytical results from analysis performed to identify the presence of PCB contamination in soils and water at two separate landfills (Landfill No. 1 and Landfill No. 2) at the facility.

23473 **(CONF-870314—10) Acid rain and weathering damage to carbonate building stone: Results of material loss measurements.** Reddy, M.M.; Youngdahl, C.A. (Geological Survey, Denver, CO (USA); Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006997.

From Corrosion '87; San Francisco, CA, USA (9 Mar 1987).

Marble and limestone specimens were exposed to atmospheric conditions at four eastern US sites. A number of methods were employed for damage assessment; this paper describes the results of chemical and physical measurements of material loss. Good agreement was observed among results obtained with different methods. A rate of surface recession near 15 μm/y was observed for skyward surfaces of marble tested in North Carolina, and comparable results were obtained at the other test sites. Response of the porous limestone was assessed with greater difficulty; a rate of loss similar to that of marble was inferred. Initial correlations of material loss with environmental factors are briefly discussed.

23474 **(DP-MS—86-112) Analysis of the validity of analytical models used for assessment of forty-five waste site areas: Subsurface flow and chemical transport.** Looney, B.B.; Fjeld, R.A.; Merrell, G.B.; Duffield, G.M.; Andrews, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Clemson Univ., SC (USA). Dept. of Environmental Systems Engineering; Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); GeoTrans, Inc., Herndon, VA (USA); Papadopulos (S.S.) and Associates, Inc., Rockville, MD (USA)). 1987. Contract AC09-76SR00001. 30p. (CONF-870252—7). NTIS, PC A03. File Number DE87006272.

From Solving ground water problems with models conference; Denver, CO, USA (10 Feb 1987).

Closure actions at 45 waste sites were analyzed using an analytical model. A quality assurance program, which consisted of (1) comparison to analytical solutions with different boundary conditions, (2) comparison of model results to measured concentrations, (3) comparison with layered numerical solutions, and (4) evaluation and sensitivity analysis of input data, suggests that this type of analysis is a reasonable screening tool. Boundary conditions and controlling processes, such as chemical speciation, must be properly identified when defining input parameters; also, transient models that account for unsaturated zone processes predict higher peak concentrations than steady-state models such as the EPA VHS model. Assessment of complex systems that have multiple flow paths, or studies of remedial actions (such as ground water withdrawal and treatment) may require numerical modeling to meet the required objectives. However, the quality assurance analysis for the subject waste sites indicates that analytical approximations are sufficiently accurate to make relative environmental assessments (e.g., prioritizing sites or assessing various closure actions).

23475 **(PB—87-126033/XAB) SOILINER Version 1 (for microcomputers). Software.** Ammon, D.C.; Otte, A. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jul 1986. vp. NTISCP T99.

The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC XT, AT, microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—87-100038.

Among the provisions of the Hazardous and Solid Waste Amendments of 1984 are minimum technological requirements for hazardous-waste landfills, surface impoundments, and waste piles. These provisions are found in Sections 3004(o) and 3015 of the Resource Conservation and Recovery Act (RCRA) and further defined in the Part 264 regulation and associated guidance. Any new surface impoundment must install two or more liners and a leachate collection system between such liners. The lower liner must be designed, operated, and constructed to prevent breakthrough of constituents over the period of operation, including any post-closure care period. A computer program, SOILINER, has been developed to assist in the evaluation of these liners. The program is for an IBM PC/XT and IBM PC/AT or compatible personal computer. Software description: The program is written in the Fortran programming language for implementation on IBM-PC-AT or XT or compatible using the DOS 2.1 (or higher) operating system. 256K bytes of core required. Hard disk required; Lotus 1-2-3 recommended for graphic output; Math co-processor chip and graphics board recommended.

23476 **(UCRL—15857) Site investigation: Hydrocarbon leak near Building 403, Lawrence Livermore National Laboratory.** (O.H. Materials Co., Findlay, OH (USA); Lawrence Livermore National Lab., CA (USA)). 12 Aug 1985. Contract W-7405-ENG-48. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87006694.

A subsurface investigation was conducted in the vicinity of building 403 at Lawrence Livermore National Laboratory to determine the extent of hydrocarbon leakage and contamination of soils surrounding underground storage tanks. The investigation included drilling borings, sampling soils, installing observation wells, sampling ground water from the newly installed and existing observation wells, chemical analyses of the soil and water samples, performing slug tests, performing a surface geophysical study, and performing a biodegradation laboratory study. The results indicate that petroleum products are present in the soils beneath the site. Based on the observed distribution of gasoline contaminated samples, it appears that the source of leakage was located at either the western edge of the southern most tank or the distribution line connected to this tank. Horizontal migration both in the saturated and unsaturated environments is very limited. Separate phase product approximately 6-inches thick is distributed in a parabolic fashion across 50 square feet, with well 403-6 as its apex.

23477 **Sulfur cycling in five forest ecosystems.** Johnson, D.W.; Richter, D.D.; Van Miegroet, H.; Cole, D.W.; Kelly, J.M. (Oak Ridge National Lab., TN, USA). *Water, Air, and Soil Pollution;* **30**: No. 3-4, 965-979(Oct 1986). (CONF-850944—). Contract AC05-84OR21400.

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

The cycling and retention of sulfur were studied in five forest ecosystems: a chestnut oak and yellow poplar stand on Walker Branch Watershed, Tennessee; a mixed oak stand on Camp Branch Watershed, Tennessee; and a red alder and Douglas-fir stand at the Thompson site, Washington. Calculations from foliage sulfur turnover indicate that about one-half of total sulfur input was dry in the Tennessee sites, whereas only one-tenth was dry in the Washington sites. Atmospheric sulfur inputs exceeded forest sulfur requirements in all cases, but three sites (chestnut oak, mixed oak, and red alder) showed a net ecosystem retention of atmospherically deposited sulfur. Net ecosystem sulfur retention was consistent with laboratory-determined sulfate adsorption isotherms within a given location (Walker Branch, Thompson site) but not between locations because of differing deposition histories and consequent differing degrees of soil sulfate saturation. No consistent relationships between soil sulfate adsorption capacity and other soil properties (pH, base saturation, iron, and aluminium oxides) were found. 33 refs.

23478 **Model for economic assessment of acid damage to building materials.** Lareau, T.J.; Horst, R.L. Jr.; Manuel, E.H. Jr.; Lipfert, F.W. (U.S. Environmental Protection Agency, Washington, DC). pp 397-410 of Materials degradation caused by acid rain. Baboian, R. Washington, DC; American Chemical Society (1986). (CONF-8506213—).

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

Using a "damage function" approach, material damages to building components associated with SO/sub 2/ and wet acidic deposition are estimated for four case-study cities. The damage function method links the physical change (corrosion or erosion) associated with changes in pollutant levels with material inventory and economic data. The valuation of damages in monetary units is based on the increased maintenance and replacement costs associated with the reduced lifetimes of material components, e.g. painted exterior walls. The damage estimates are better than those heretofore available, given improvements in the quality and resolution of the material inventory and air quality data that have been developed as part of the National Acid Precipitation Assessment Program.

23479 **Effects of atmospheric exposure on roughening, recession, and chemical alteration of marble and limestone sample surfaces in the eastern United States.** Youngdahl, C.A.; Doe, B.R. (Argonne National Lab., Argonne, IL). pp 266-284 of Materials degradation caused by acid rain. Baboian, R. Washington, DC; American Chemical Society (1986). (CONF-8506213—).

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

Marble and limestone surfaces were exposed to atmospheric conditions at four eastern U.S. sites and were monitored for changes in surface chemistry, surface roughness/recession, and weight. The effect of acid deposition, to which calcareous materials are especially sensitive, was of particular interest. Results are described for the first year of testing, and aspects of a preliminary equation to relate damage to environmental factors are discussed. Thus far, findings support that acid deposition substantially damages marble and limestone surfaces. Improvements in methods to reduce uncertainties in the quantitative contributions of important chemical species are outlined for the ongoing effort.

23480 Cultural resource monitoring: Concurrent aerometric and materials deterioration studies at Mesa Verde National Park. Dolske, D.A.; Petuskey, W.T. (Illinois Dept. of Energy and Natural Resources, Champaign, IL). pp 259-265 of Materials degradation caused by acid rain. Baboian, R. Washington, DC; American Chemical Society (1986). (CONF-8506213—).

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

The effects of acid deposition on the sandstone masonry of Anasazi cliff-dwelling ruins at Mesa Verde National Park, Colorado, are being investigated. Potential correlations are sought between surface erosion rates and continuously monitored aerometric parameters. A mechanism of deterioration by acceleration of natural erosion processes is hypothesized. Gaseous and particulate pollutant concentrations and meteorological variables are measured at Spruce Tree House ruin. Two test walls, closely resembling Anasazi structures, have been constructed of sandstone specimens typical of masonry units found at Mesa Verde. Deterioration of the stone occurs by a combination of chemical and mechanical processes which weaken the material which bonds the quartz grains. The surface recession rate is periodically recorded using photogrammetry, and microstructural and microchemical alterations in the bonding phase are observed using optical and electron probing techniques. Backscattered-imaging electron microscopy is sensitive to the chemistry of constituent phases, with spatial resolution equivalent to secondary electron imaging. The monitoring scheme is discussed in the context of ongoing research.

23481 Effects of acid deposition on Portland cement concrete. Webster, R.P.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY). pp 239-249 of Materials degradation caused by acid rain. Baboian, R. Washington, DC; American Chemical Society (1986). (CONF-8506213—).

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

Presented are the results of a program, sponsored by the Environmental Protection Agency, conducted to determine the state-of-the-art knowledge pertaining to the effects of acid deposition on the properties of Portland cement concrete structures (PCC). Information was collected from a computerized literature survey, interviews, and replies to mail and telephone inquiries addressed to cement and concrete researchers and to governmental agencies and private firms active in the maintenance and restoration of concrete structures. In general, the study revealed very little qualitative or quantitative information on the effects of acid deposition on PCC structures. The rate of deterioration of reinforced PCC structures in polluted areas, however, appears to be increasing, and available information makes it readily apparent that acids and acid waters significantly affect the durability of concrete, and that SO/sub 2/, NO/sub x/, and HCl accelerate the corrosion of reinforcing steel. On the basis of this evidence, it was recommended that an experimental test program, consisting of both laboratory and field tests, be developed and implemented to quantitatively measure the effects of acid deposition on PCC structures.

23482 Application of a theory for economic assessment of corrosion damage. Lipfert, F.W.; Wyzga, R.E. (Brookhaven National Lab., Upton, NY). pp 411-430 of Materials degradation caused by acid rain. Baboian, R. Washington, DC; American Chemical Society (1986). (CONF-8506213—).

From State-of-the-art symposium on degradation of materials due to acid rain; Arlington, VA, USA (17 Jun 1985).

Deterioration of materials in the built environment is one of the considerations with regards to the justification for more stringent controls on anthropogenic pollution sources. There are both economic and aesthetic concerns involved: reduced service life of common construction materials is primarily an economic consideration, while irreversible damage to art objects and historic buildings has a strong emotional context as well. Damage to monuments and carved building stone has been observed and documented, both in this country and more extensively in Europe. Sorting out cause and effect, i.e., separating "natural" weathering from pollution-induced damage involves use of planned experiments to develop damage functions, either in the field or under laboratory conditions. Most of the knowledge of the deterioration of building materials comes from such experiments, which have usually been performed on standard test configurations rather than on actual building components. The current capability for economic assessment of materials damage then depends heavily on the extrapolation of test conditions to the real world. The real world of today's built environment differs from both current and past testing conditions in many important ways. It is the purpose of this paper to explore these differences on a theoretical basis and to consider whether the concomitant uncertainties in the prediction of reduced service lives are tractable and whether important biases are involved.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 22280, 22499, 23417, 23451, 23458, 23459, 23460, 23465, 23527, 23650, 23669

23483 (CLOR—116/D) Influence of industry on pollution of the environment and human population with natural radionuclides and heavy metals. Jaworowski, Z. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). 1982. 152p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87701495.

The rate of fallout of /sup 226/Ra depending on the distance from industrial emission sources has been evaluated. Contamination of soil with natural radionuclides in industrial and rural regions of Poland has been compared with the concentration of radionuclides in ash of aerophytic plants. An increase of airborne pollutants in precipitation in Southern Poland has been compared with an increase of the concentration of pollutants in pine trees. Samples of human bones from Southern Poland have been checked for contents of lead. It has been found that in 20th century concentration of lead decreased to a level not much higher than natural. The level of /sup 226/Ra in Polish population had been decreasing during the last 100 years. This points to the conclusion that human skeleton is well protected as the level of radionuclides was not related to the level of environmental pollution. The concentration of /sup 226/Ra in air is steadily increasing and an upward transport leads to its wide distribution. (E.G.M.).

23484 (GSF—18/86) Intercomparison of the terrestrial food chain models FOOD-MARC and ECOSYS. Proehl, G.; Friedland, W.; Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Dec 1985. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751227.

Time-dependent food chain models, FOOD-MARC and ECOSYS, have been developed independently at the NRPB and at the GSF respectively. Both models are compared with respect to the model assumptions and the parameters used. A further point of this study is the analysis of the influence of actual differences in agricultural conditions in the United Kingdom and the Federal Republic of Germany on the results. A single deposition of 1 Bq/m/sup 2/ was assumed of selected radionuclides on an area in agricultural use. The endpoints considered are the resulting activity concentrations in plant and animal foodstuffs as a function of time after deposition. The cumulative concentrations integrated over 50 years are calculated. A deposition in winter (January 1) and another one in summer (July 1) are considered separately to point out the seasonal influence on the contamination of foodstuffs. In this comparison, the products vegetables, grain, roots, milk, meat, and the radionuclides Sr-89/90, Ru-106, Cs-134/137, I-129/131/133, and Pu-239 are taken into account. The activity concentrations in food products are calculated for the times 7 d, 30 d, 100 d, 200 d, 1 a, 2 a, 5 a, 10 a, 20 a, and 50 a after the single deposition on January 1 or July 1.

23485 (IFE/KR/E—86/003) Run-off of strontium with melting snow in spring. Quenild, C.; Tveten, U. (Institute for Energy Technology, Kjeller (Norway)). Sep 10086. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750697.

When assessing the consequences of atmospheric releases caused by a large reactor accident, one usually finds that the major contributions to the dose are via nutrition and from exposure to radiation from radioactive materials deposited on ground. The experi-

ment described is concerned with run-off from agricultural surface which has been contaminated with strontiom while covered with snow. Migration experiments show a significant difference between summer and winter conditions. Roughly 54% of the strontium with which the experimental area was contaminated, ran off with the melt-water. Under winter conditions, portions of the contaminant will flow with the melt-water without coming in contact with the soil.

23486 (INIS-mf—10577, pp 13) **Identification of oxidation state of plutonium in the snow layers, High Tatras, Czechoslovakia.** Burcik, I.; Navarcik, I.; Bartha, S. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice, Czechoslovakia). 21 Apr 1986. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701572. (CONF-8509125—Exc.-Absts.).

From Conference on separation of ionic solutes; Smolenice, Czechoslovakia (2 Sep 1985).

23487 (INIS-mf—10581, pp 22-23) **Studies on radionuclide distribution using alpha fission track analysis.** Gray, D.J.; Davey, B.G.; Ellis, W.R.; Wall, T. (Sydney Univ., Australia. Dept. of Soil Science; Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Work supported by the United States Nuclear Regulatory Commission has involved the study of the redistribution of radionuclides in the upper sequences of the uranium deposits of the Alligator Rives uranium field. Alpha and fission track analysis were selected as techniques for investigating the physical distribution of radionuclides, which would then be related to the mineralogy and degree of weathering. It was observed that radionuclides were predominantly found in veins in unweathered and partially weathered rock and were associated with the iron oxides in the soil profile.

23488 (INIS-mf—10581, pp 78-82) **Role of nuclear techniques in the long-term prediction of radionuclide transport.** Airey, P.L.; Duerden, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Problems associated with the long-term prediction of the migration of radionuclides, and the role of natural analogues in reducing the inherent uncertainties are discussed. Particular reference is made to the evaluation of uranium ore bodies in the Alligator Rivers region, Northern Territory, as analogues of high-level radioactive waste repositories. A range of nuclear techniques has been used to identify the role of colloids, of alpha recoil and of mineralogy in transport. Specific mention is made of a method being developed which enables models of the migration of solute through fractured rock to be assessed via a combination of alpha track, fission track and PIXE/PIGME techniques.

23489 **(LA—10893-MS) Investigation of thorium contamination at two target areas at White Sands Missile Range.** Buhl, T.; Van Etten, D.; Hansen, W.R. (Los Alamos National Lab., NM (USA)). Feb 1987. Contract W-7405-ENG-36. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006321.

Possible /sup 232/228/Th contamination was investigated at the SC-50 and Hayfield areas at White Sands Missile Range that were formerly used as targets for the missile testing program. Approximately 200 soil samples were collected from the target areas and analyzed for thorium and uranium. In addition to soil sampling for uranium and thorium, the area was scanned using high sensitivity NaI (T1) search meters mounted on the Laboratory's Environmental Surveillance Van, and four in-situ gamma spectra were taken in the two target areas. Aside from thorium alloy fragments in the centimeter size range that are still present in small amounts at both sites, no detectable contamination was found in either area. The thorium concentrations are considerably less than the Soil Concentration Guide for above-background thorium informally issued for this project by the US Army Test and Evaluation Command. The lower limits of detection of above-background thorium were less than 10% of the soil guide.

23490 **(NTB—85-16) Concentration ratios for BIOPATH: selection of the soil-to-plant concentration ratio database.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 40p. Nagra, Ch-5401 Baden, Switzerland.

In Switzerland, high-level radioactive waste is planned to be deposited in deep crystalline formations. 'BIOPATH' is the computer code which has been used to simulate the movement of radionuclides in the biosphere, in order to calculate the doses to man. The key parameter used in the model on which the code is based is the concentration ratio (CR). This specifies the transfer of individual radionuclides via the various foodchains, ultimately to man. Five types of CR are required for the model, namely soil to plant, intake by cattle to milk, intake by cattle to meat, intake by poultry to eggs and from water to fish. Each of these CR are discussed in turn; it is shown that soil to plant CR exhibit a variability that greatly exceeds that observed in the other types of CR and for this reason the report goes on to consider these in much closer detail. The different methods and experimental techniques used to derive soil to plant CR are examined and assessed, to allow evaluation of a meaningful data base for use in BIOPATH. The report concludes by examining the data available for each radionuclide in turn and listing a recommended CR for it, to input into the BIOPATH model.

23491 **(RISO-M—2598) Method for consequence calculations for severe accidents. Transient accident with safety valve at Ringhals 1.** Nielsen, F.; Thykier-Nielsen, S.; Walmod-Larsen, O. (Risoe National Lab., Roskilde (Denmark)). Aug 1986. 63p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750662.

This report was commissioned by the Swedish State Power Board, who wanted a method for calculation of radiation doses in the surroundings of nuclear power plants caused by severe accidents. The PLUCON4 code were used for the calculations. A TC-SV-accident at Ringhals 1 wer chosen as example. A transient without shutdown leads to core meltdown through the reactor vessel. The pressure peak at the moment of vessel failure opens a safety valve in the dry well. Meteorolgical data for two years from the Ringhals meteorological tower were analysed to find representative weather situations. As typical weather were chosen Pasquill D with wind speed 8 m/s, and as extreme weather were chosen Pasquill F with wind speed 4.8 m/s.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 22254

23492 **(DOE/RA/50358—T1) A comprehensive study on the feasibility of energy recovery from sewage sludge: Final report.** Ahmad, J.; Ferrand, E.F.; Pressman, W. (Cooper Union Research Foundation, New York (USA); New York City Bureau of Science and Technology (USA). Environmental Protection Dept.). Jul 1985. Contract FG01-80RA50358. 112p. NTIS, PC A06. File Number DE87007029.

To determine the feasibility, from an energy, economic and environmental standpoint, of converting sewage sludge into fuel that can replace or supplement existing fuels, this study: evaluated the technology and design aspects of the dewatering and drying of sludge using centrifuges and the Carver-Greenfield multiple-effect evaporation process to establish technologically feasible limits for plant design and operating conditions; evaluated the technology and design aspects of the fluidized-bed combustion of a range of product feedstocks available from the centrifuge-Carver-Greenfield process to establish technologically feasible limits for plant design and operating conditions; evaluated the technology and design aspects of control devices and process strategies and the restraints imposed by the Clean Air Act, Clean Water Act, State and City laws and regulations to establish range of design and operating condi-

tions for both the fuel preparation and fuel combustion processes that will satisfy environmental goals; performed an in-depth analysis of the economics, energy and mass balances for the alternate design and operating conditions; coordinated activities of the study with the Bureau of Water Pollution Control; and prepared a conceptual design as the basis for construction of a plant for national use.

23493 **(UCRL—15850) Hazardous waste site assessment: Inactive landfill, Site 300, Lawrence Livermore National Laboratory.** (Lawrence Livermore National Lab., CA (USA); CH2M Hill California, Inc., Emeryville (USA)). Jan 1985. Contract W-7405-ENG-48. 187p. NTIS, PC A09. File Number DE87006696.

This report presents the results of an investigation of an inactive landfill (Pit 6) at Lawrence Livermore National Laboratory's (LLNL) Site 300. The primary objectives were to: collect and review background information pertaining to past waste disposal practices and previous environmental characterization studies; conduct a geophysical survey of the landfill area to locate the buried wastes; conduct a hydrogeologic investigation to provide additional data on the rate and direction of groundwater flow, the extent of any groundwater contamination, and to investigate the connection, if any, of the shallow groundwater beneath the landfill with the local drinking water supply; conduct a risk assessment to identify the degree of threat posed by the landfill to the public health and environment; compile a preliminary list of feasible long-term remedial action alternatives for the landfill; and develop a list of recommendations for any interim measures necessary at the landfill should the long-term remedial action plan be needed.

23494 **(UCRL—15880) Technical report of biota, FEL Site 2, Lawrence Livermore National Laboratory: Final report.** Taylor, D.W.; Davilla, W.; Orloff, S. (BioSystems Analysis, Inc., Sausalito, CA (USA); Lawrence Livermore National Lab., CA (USA)). 26 Sep 1986. Contract W-7405-ENG-48. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006720.

Lawrence Livermore National Laboratory is considering expansion of laser test facilities adjacent to its existing LLNL Site 300 test location. Construction of a free-electron laser, known as the FEL Project, is being considered on approximately 9600 hectares (24,000 acres) of land immediately southeast of Site 300. This report quantitatively describes the variation of vegetation on FEL Site 2, and relates the vegetation to potential environmental impacts associated with present operation and possible expansion of site facilities. The presence and status of any endangered, threatened, fully protected, or otherwise sensitive species of wildlife on FEL Site 2 that might be affected by site operations and developments was also determined. We directed our studies mainly toward the federally endangered San Joaquin kit for (Vulpes macrotis mutica), but also toward another 14 special status species that potentially occur on site, including the state threatened Alameda striped racer (Masticophis lateralis euryxanthus).

23495 **(UCRL—15883-Vol.1) Waste minimization study for the Lawrence Livermore National Laboratory: Final report.** (Bechtel National, Inc., San Francisco, CA (USA); Lawrence Livermore National Lab., CA (USA)). 26 Nov 1986. Contract W-7405-ENG-48. 158p. NTIS, PC A08. File Number DE87006727.

The Laboratory is a large facility which contains many diverse programs (Figure A1). Each program has processes which are unique to it and as a result may have hazardous wastes which are distinctly different from other programs. A waste minimization plan would therefore have to effectively cover each and every program individually. A program generating a large volume of hazardous waste may require less time and effort than a program which generates a small amount of less hazardous waste. It was not possible to cover all the programs in the course of this study. In this study, the four largest volume generators were selected primarily because waste reduction at these programs could significantly reduce total waste at the Laboratory and also because data generated in the course of the study could be used in the on-going design of the LLNL Decontamination and Waste Treatment Facility (DWTF). These progrms include Plating Shops, Experimental Circuit Board, Nuclear Chemistry and General Plant. A report for each of these programs is included in this final report.

5106 Regulations

REFER ALSO TO CITATION(S) 22662

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 22253, 23467, 23468

23496 **(CONF-870259—2) Production of soluble, high molecular weight phosphorus and its subsequent uptake by stream detritus.** Mulholland, P.J.; Minear, R.A.; Elwood, J.W. (Oak Ridge National Lab., TN (USA); Illinois Univ., Urbana (USA). Inst. for Environmental Studies). 8 Feb 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005337.

From 23. congress of the Society of Theoretical and Applied Limology; Hamilton, New Zealand (8 Feb 1987).

Several studies have demonstrated the importance of non-orthophosphate compounds, including some of relatively high molecular weight, in phosphorus cycling in aquatic ecosystems. This paper reports results from a laboratory study indicating that some of the soluble phosphorus released by microbes associated with coarse and fine detritus in streams is of relatively high molecular weight (>5000 daltons) and that this phosphorus is subsequently utilized, but at rates considerably lower than for orthophosphate.

23497 **(CONF-870259—3) Microbial activity and phosphorus uptake on decomposing leaf detritus in a heterotrophic stream.** Elwood, J.W.; Mulholland, P.J.; Newbold, J.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01. File Number DE87006205.

From 23. congress of the Society of Theoretical and Applied Limology; Hamilton, New Zealand (8 Feb 1987).

This paper reports results of experiments to determine the influence of microbes associated with decomposing leaf detritus on the uptake length and retention of phosphorus in a heterotrophic stream. The purposes were to (1) determine the relationship between the biomass and activity of microbes associated with decomposing leaf detritus and the uptake length of PO_4-P in a stream; (2) compare the temporal pattern in the uptake rate of phosphorus among species of leaves that have been shown to differ in their rate of decomposition as a function of time in a stream; and (3) examine the temporal patterns in the net accumulation, leaching, and transformations of phosphorus in flow-through systems containing decomposing leaf detritus.

23498 **(DOE/ER/60354—2) Biological processes in the water column of the South Atlantic Bight: Zooplankton responses: A progress report, June 1986 to June 1987.** Paffenhoefer, G.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 19 Dec 1986. Contract FG09-85ER60354. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006735.

During April of 1984 and 1985 we studied the effects of wind forcing on water flow on the inner and middle shelf off Georgia and South Carolina. We present in this Progress Report selected data from our SPREX cruise (Spring Runoff Experiment) in April 1985 and compare the date with results from our Pre-SPREX cruise in April 1984. River runoff in April 1985 was about 50% lower than the previous average. The overall water flow at mid-shelf off Charleston was alongshore at the surface and onshore near bottom. The water column was well mixed and started to show signs of stratification by the end of April 1985. The water flow data indicate that nearshore zooplankton would hardly be displaced towards offshore, whereas offshore zooplankton would be transported towards shore. A comparison of results from April 1984 with those from April 1985 shows major differences: Fairly high runoff and pronounced displacement of nearshore water towards offshore with northeastward wind stress resulted in strong offshore displace-

ment of estuarine zooplankton in surface waters (April 1984). Low runoff and weak alongshore displacement of surface water with weak windstress resulted in no offshore displacement of estuarine zooplankton which were at abnormally low concentrations in their habitat (April 1985).

23499 (IAEA-TECDOC—381) **Mathematical models for interpretation of tracer data in groundwater hydrology. Proceedings of an advisory group meeting held in Vienna, 17-21 September 1984.** (International Atomic Energy Agency, Vienna (Austria)). Jul 1986. 234p. (CONF-8409389—). NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515.

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The Advisory Group Meeting had the overall objective of discussing in detail the methodologies and approaches in the development of mathematical models for quantitative evaluations of tracer data in groundwater hydrology and reviewing the recent advances in this field. A separate abstract was prepared for each of the eight papers. Refs, figs and tabs.

23500 (IAEA-TECDOC—381, pp 45-68) **General review of methodologies and approaches in mathematical models for interpretation of tracer data in hydrological systems.** Goblet, P. (Ecole Nationale Superieure des Mines, 77 - Fontainebleau, France. Centre d'Informatique Geologique). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

A general review of the mass transport mechanisms in saturated groundwater flow and related basic concepts are provided. Available methodologies for numerical simulation of mass transfer and their applicability are discussed. 27 refs.

23501 (IAEA-TECDOC—381, pp 69-116) **Review of existing mathematical models for interpretation of tracer data in hydrology.** Zuber, A. (Institute of Nuclear Physics, Krakow, Poland). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The paper reviews advantages and limitations of the mathematical models applied for the interpretation of artificial tracer experiments and environmental tracer data. 82 refs, 8 figs, 1 tab.

23502 (IAEA-TECDOC—381, pp 117-137) **Role of tracer data for modeling soil-water flow in the unsaturated zone.** Sonntag, C. (Heidelberg Univ., Germany, F.R. Inst. fuer Umweltphysik). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The paper provides a review of the basic formalisms and concepts involved in soil moisture flow in the unsaturated zone and discusses the potential contribution of tracer studies for this purpose. 18 refs, 9 figs.

23503 (IAEA-TECDOC—381, pp 139-164) **Solute transport in fractured rocks.** Neretnieks, I. (Royal Inst. of Tech., Stockholm, Sweden. Dept. of Chemical Engineering). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The paper describes the basic physical processes involved in solute transport in fractured rocks. Mathematical formulations available for this purpose and the methodologies used in evaluating the tracer experiments in fractured aquifer systems are reviewed. 32 refs, 7 figs, 2 tabs.

23504 (IAEA-TECDOC—381, pp 165-179) **Computer modelling of confined aquifer systems for interpretation of chemical and environmental isotope data.** Geyh, M.A. (Niedersaechsisches Landesamt fuer Bodenforschung, Hannover, Germany, F.R.). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

Use of a hydraulic flow model for interpretation of chemical and environmental isotope data in confined aquifer systems is described. Analytical and numerical approaches for steady-state flow cases are provided. Extension of the methodology to non-steady-flow conditions are discussed. 16 refs, 7 figs.

23505 (IAEA-TECDOC—381, pp 181-201) **Application of a transport-diffusion model to a coastal aquifer utilizing in situ measurements of dispersivity.** Troisi, S.; Vurro, M.; Castellano, L. (Experimental Lab. of Bari, Italy. Water Research Inst.; Milan Univ., Italy. Ist. di Fisica). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

Some classical experimental ("two-well pulse method") and theoretical (hydrodispersive scheme) methodologies commonly used to analyze porous media have been applied to the Nardo Aquifer (Southern Italy). The results have been satisfactory only in the case of natural flow. Some recent pumping tests indicate that the tracer spreading has a high sensitivity to the pumping rate. 40 refs, 16 figs.

23506 (IAEA-TECDOC—381, pp 203-222) **Use of linear compartmental simulation approach for quantitative interpretation of isotope data under time variant flow conditions.** Yurtsever, Y.; Payne, B.R.; Gomez Martos, M. (International Atomic Energy Agency, Vienna, Austria. Div. of Research and Labs.). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The use of environmental tritium for the quantitative evaluation of the hydrodynamic parameters of a hydrological system requires development of a mathematical model to describe the tracer input/output relationship. The paper describes the use of a multicompartmental mixing model approach for time-variant flow conditions as a tool for quantitative evaluation of environmental isotope data. The approach enables simulation of both the flow and tracer distribution through the system to provide estimates of parameters related to flow dynamics. The environmental tritium data collected in the Yesildere river basin are used for the development of such a time variant multicompartmental mixing model as an illustration of the approach. The results obtained from model simulation studies for this river basin are presented. 8 refs, 9 figs, 3 tabs.

23507 **(PNL-SA—14439) Allochthonous detritus input to a small, cold desert spring-stream.** Cushing, C.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 21p. (CONF-870259—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006440.

From 23. congress of the Society of Theoretical and Applied Limology; Hamilton, New Zealand (8 Feb 1987).

The amount of allochthonous detritus deposited or transported into Snively Springs, a small, cold desert spring-stream system in south-central Washington, was measured. The importance of this energy source to the ecosystem is discussed. (ACR)

23508 **(PPA-CR—5) Use of environmental isotopes in hydrogeological studies in Kedah and Perlis, Malaysia. Project proposal summary.** (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Jan 1981. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701452.

A preliminary study of the isotope hydrology of the Kedah and Perlis area was undertaken under the RCA programme. This project is an attempt at elucidating the mechanism of recharge, origin, area of recharge and dating of groundwater system in the area. The results show that all groundwater samples in the area vary within a narrow range for /sup 18/0 (-7.58 to -5.06%) while / sup 2/H ranges from -50.3 to -35.1%. The mean isotopic composition of precipitation collected at Alor Star meteorological station fall within the range of variation of the Kedah/Perlis groundwaters. In the southern part of the study site, the isotopic results indicate the occurence of two types of water; firstly the recharge is from the highlands where more negative /sup 18/0 values and low tritium were observed and the second type is of local recharge where high tritium and less negative /sup 18/0 values were observed. On the other hand, in the northern part of the basin the interpretation of stable isotopic results is quite difficult to be made at this stage. There was no correlation at all between tritium and /sup 18/0 whatsoever. Results of the tritium assay show that some of the groundwater samples are pre-nuclear in age as indicated by low tritium content. Consequently, a Carbon-14 investigation was carried out from a few selected sites and their ages were found to be in the range of about 3000 to 5000 years.

23509 (PPA-PR—1) Preliminary study of the environmental isotopes in hydrology in the Lower Kelantan River Basin, Kelantan, Malaysia. IAEA Regional Cooperative Agreement. Project 13 - isotope hydrology and sedimentology. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Feb 1981. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701453.

A preliminary study of the isotope hydrology of the Lower Kelantan River Basin is presented. The overall aims of this investigation are to study the groundwater movement, re-charge areas, direction and flowrate and also to identify the recharge mechanism of the existing aquifers. The results show that all groundwater samples in the area vary within a narrow range for Oxygen-18 (-5.66 to -7.64) whilst isotope of Hydrogen -2 ranges from -34.1 to -48.8. The Kelantan River water contains -6.84 for Oxygen-18 and -45.0 for / sup 2/H. Tritium data confirm that all groundwater samples of third aquifer is older than 25 years and most waters from the first and second aquifers are younger than 25 years. The isotopic data demonstrates that the first aquifer is recharged either by precipitation and/or river water in locations where high tritium and less negative 8-values are observed and by the third aquifer in locations with low tritium and more negative 8-values, the recharging of the second aquifer seems to be from the first and third aquifers as the second aquifer has 8-values ranging from those of the first and third aquifers; the recharge mechanism of the third aquifer cannot be established with the present data, a more detailed investigation is needed. From the chemical and isotopic results it seems that the salt content increases in waters are derived from leaching the aquifer matrix rather than from sea water intrusion. However, more wells and samples are expected to be collected in the second sampling programme in order to visualise clearly the regional hydrogeological system of the area. Nevertheless, some important conclusions that have been drawn from this study will be very useful as a guideline to further investigation and planning of groundwater management.

23510 (PPA-PR—8) Application of Cs-137 techniques to problems of sediment redistribution in Sungai Lui representative basin, Selangor, Malaysia (Part 1). IAEA Regional Cooperative Agreement (MAL2623/R1/AG). Daud bin Mohamad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Nov 1982. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701594.

Since the beginning of the nuclear age, Cesium-137 has become a part of the world's ecosystems. Cs-137 is carried from the atmosphere to the ground by rainfall. On reaching the earth's surface, /sup 137/Cs becomes strongly adsorbed to soil profiles and is concentrated predominantly in the surface layer, particularly in clayey soils. Systematic measurements of Cs-137 levels will therefore permit estimates to be made of the cumulative effects of soil redistribution over the past 25 years. Sediment movement in river catchments and coastal areas is a very old problem in Malaysia. In view of rapid development of urban and agricultural areas in Malaysia it was realised tha soil loss problems are particularly serious. The Sungai Lui catchment was chosen to be the investigational site. Geologically, the area comprises of granite and granitic schist. The area is mostly covered by forest (approx. 83%) and rubber (13%), padi (2%) and others (2%). The climate is considered to be typical of Peninsular Malaysia (equatorial) characterised by uniform temperature, high humidity and high rainfall. The area is mainly drained by the Lui River. Soil samples were collected from the catchment area at 4 sampling points in April 1981. The results of analyses of Cs-137 in soil samples from Sungai Lui catchment area ranged from 1.3 to 6.8 M Bq g/sup -1/ of sample and they could still be detected even up to 20 cm depth. A general pattern of Cs-137 distribution was observed in the soil profile at each site. The highest activity being in the top 3 cm layer and then decreasing up to about 6 cm. The activity increases again up to about 9 cm layer. From there onwards, it decreases. Based on these results, the estimated rate of sediment accumulation in the area was found to be about 0.47 cm/year. Since the samples were only collected from the depositional sites, further sampling especially from erosional site should therefore be carried out in order to obtain more complete data.

23511 (PPA-PR—9.1) Report on the environmental isotopic investigations in Lower Kelantan River Basin, Malaysia. (Part II). IAEA Regional Cooperative Agreement MAL2623/ R1/AG. Daud bin Mohamad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Nov 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701595.

A pilot project on isotope hydrology of the Lower Kelantan Basin was undertaken under the RCA programme since March 1980. The principal objective of this project is to develop isotope hydrological techniques as an investigational tool and to complement work by conventional methods at the Geological Survey of Malaysia and universities in Malaysia. The groundwater in the Lower Kelantan Basin chosen in this project is of great economic significance. The overall aim of these investigations is to study the groundwater movement, recharge areas, direction and flowrate and also to identify the recharge mechanism of the existing aquifers. Groundwater samples were collected from 45 sampling locations in 9 sampling campaigns. The results show that all groundwater samples in the area vary within a narrow range for stable isotope /sup 18/0 (-5.56 to -7.79%) and deuterium (-34.8 to 50.0%) with respect to SMOW standard. While the mean isotope values of Kelantan River and Kota Bharu precipitation are (/sup 18/0 = -6.93%, /sup 2/H = -45.%, /sup 3/H = 8.1 T.U) and (/sup 18/0 =-7.47%, /sup 2/H = -46,4%, /sup 3/H = 5.6 T.U.), respectively. The relationship of SD and SO for all samples is SD = 7.6 SO + and the local precipitation line is also indicated. On the basis of the isotopic data a comparison of the groundwaters of three aquifer is made. Most groundwater of the aquifers was younger than 25 years, whereas all groundwater samples of the third aquifer are older than 25 years. / sup 14/C concentrations in an attempt to determine the age of the groundwater. The /sup 14/C results show that their age ranges from 2000 to 11,000 years old. All deep wells and most of the wells located near the Kelantan River do not seem to receive any river water contribution whatsoever. However, the shallow wells at a few locations seemed to be affected by river water unfiltration to a certain extent. (Abstract Truncated)

23512 (PPA-PR—9.2) Report on the environmental isotopic investigations in Lower Kelantan River Basin, Malaysia (Part 3). IAEA Regional Cooperative Agreement (MAL2623/ R1/AG). Daud bin Mohamad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Jul 1983. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701596.

A pilot project on isotope hydrology of the Lower Kelantan Basin was undertaken since March 1980. The principal objective of this project is to develop isotope hydrological techniques as an investigational tool and to complement work by conventional methods at the Geological Survey of Malaysia and universities in Malaysia. The overall aim of these investigations is to study the groundwater movement, recharge areas, direction and flowrate and also to identify the recharge mechanism of the existing aquifers. The isotopic data demonstrates that the groundwater is recharged locally through precipitation. Low tritium values observed in the second and third aquifer suggest that the groundwater in these aquifers comprises an old water component. As a whole, these three

aquifers are interconnected in places and regionally they may be considered as representing a single system. This was evidently shown by small variations in their isotopic contents; with the first aquifer being unconfined, while the second and third are semi-confined. Trituim data confirmed that all groundwater samples on the third aquifer are older than 25 years and most waters from the first and second aquifers are younger than 25 years. Consequently a few selected samples from the third aquifer were analysed for /sup 14/C concentrations in an attempt to determine the age of the groundwaters. The /sup 14/C results show that their age ranges from 2000 to 11,000 years old. All deep wells and most of the wells located near the Kelantan River do not seem to receive any river water contribution whatsoever. However, it seemed that the shallow wells at a few locations were affected by river water unfiltration to a certain extent. Some important findings that have emerged from this study will be very useful in the planning of the implementation of groundwater management in Malaysia, in particular the Kelantan Basin.

23513 **(PPA-PR—10) Report on the environmental isotopic investigations in Kedah and Perlis Area, Malaysia (Part 1). IAEA Regional Cooperative Agreement (MAL2623/R1/AG).** Daud bin Mohamad. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Nov 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701597.

A preliminary study of the isotope hydrology of the Kedah and Perlis area was undertaken under the RCA programme. This project is an attempt at elucidating the mechanism of recharge, origin, area of recharge and dating of groundwater system in the area. The results show that all groundwater samples in the area vary within a narrow range for /sup 18/0 (-7.58 to -5.06%) while /sup 2/H ranges from -50.3 to -35.1%. The mean isotopic composition of precipitation collected at Alor Star meteorological station fall within the range of variation of the Kedah/Perlis groundwaters. In the southern part of the study site, the isotopic results indicate the occurence of two types of water: firstly, the recharge is from the highlands where more negative /sup 18/0 values and low tritium were observed and the second type is of local recharge where high tritium and less negative /sup 18/0 values were observed. On the other hand, in the northern part of the basin the interpretation of stable isotopic results is quite difficult to be made at this stage. There was no correlation at all between tritium and /sup 18/0 whatsoever. Results of the tritium assay show that some of the groundwater samples are pre-nuclear in age as indicated by low tritium content. Consequently, a Carbon-14 investigation was carried out from a few selected sites and their ages were found to be in the range of about 3000 to 5000 years.

23514 **(PPA-PR—11) Tritium, deuterium and oxygen-18 content of rainwater from Pengkalan Chepa, Kota Bharu, Malaysia. (April 1980-January 1983).** (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Jul 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701454.

Samples of monthly precipitation have been collected for isotope analysis from Pengkalan Chepa Meteorological Station since March 1980. This information is necessary to provide basic data for hydrological application of environmental isotopes studies undertaken in Malaysia, in particular the Kelantan Basin study. The overall weighted-mean values of /sup 18/0 and /sup 2/H of the Kota Bharu precipitation are -7.47% and -46.4%, respectively. The δD-δO plot best fit line to the data by Orthogonal Method is indicated by the following relationship: δD=(8.1 +- 0.1) δO + (13.7 +- 0.4). The Kota Bharu precipitation has a deuterium excess of 13.4 and the slope is comparable to that of the World Meteoric Line. The plot of mean monthly δO and precipitation has a relationship as follows: δO = (-0.0167 +- 0.0005) x Prec. (-3.56 +- 0.09). The relationship indicates an average depletion rate of -1.67% per 100 mm of rainfall. This phenomenon indicates that δ values are considerably governed by the intensity of rainfall, similarly, this is also observed in the frequency analyses of both /sup 18/0 and /sup 2/H and so the Rainfall and /sup 18/0 Versus Time diagram. Tritium varies within a small range (i.e. from 4.0 to 7.7 T.U.), with maximum concentration in the month of July and minimum concentration in December. The weighted mean value of tritium in precipitation is 5.0 T.U. The concentration of tritium is generally low because of the strong dilution by the oceanic water vapour. The trend is the same as found in other IAEA network stations in tropical regions.

23515 **(PPA-T—21) Procedures for determining stream flowrate using radioisotope method in Pesanggrahan River, Indonesia.** (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Aug 1983. 35p. (In Malay). Nuclar Energy Unit, Kompleks PUSPATI, 43000 Kajang (MY).

River flow measurements either by a current meter or a tracer dilution are established elsewhere. This report describes the experimental method, calibrations of NaI detector, preparation of radioisotopes and equipment, and safety aspect considerations as well as results interpretation in determining stream flowrate of Pesanggrahan River, Indonesia in which radioisotopes /sup 82/Br and /sup 51/Cr complexed with EDTA were used as tracers. The total count technique of stream flow D=AF/N, developed by Hull, was simplified for the ease of field work purposes and adopted in this study. Discharge results at different water levels during low flows gauged using both radioisotope tracers are comparable. The relationship between water level and discharge value is also plotted although the available data is insufficient.

23516 **Icelandic sea-ice record.** Kelly, P.M.; Goodess, C.M.; Cherry, B.S.G. *Climate Monitor;* **15**: No. 1, 11-17(1986). Contract FG02-85ER60316.

Because the presence or absence of ice has always had significant implications for Iceland, many observations of unusual sea-ice conditions and climatic events exist, extending back to the colonization of the country some 1000 years ago. The various forms of climate data have been collated, updated, and indexed; the index is now maintained by the Iceland Meteorological Office. Because of its length and documented reliability, this data set is one of the most valuable climate indicators available. While not representative of large-scale processes, the Iceland ice index is a reasonable indicator of the nature of the winds north of Iceland and of the underlying ocean transport. The East Greenland Current plays a major role in the meridional transport of energy and the Icelandic data must be regarded as a valuable measure of the state of this important component of the energy balance of the climate system.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 22154, 23073, 23431, 23435, 23481, 23493, 23531

23517 **(EPRI-EA—5079) Artificial streams for ecosystem toxicity studies: Final report.** Warren, C.E.; Liss, W.J.; Wevers, M.J.; Burnett, K.M.; Corrarino, C.A.; Curtis, L.R.; Frissell, C.A.; Hoffman, R.L.; Hurley, M.D.; Melton, L.A. (Oregon State Univ., Corvallis (USA). Dept. of Fisheries and Wildlife; Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 235p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920281.

Watershed and stream ecosystem theory, classification and empirical approaches were employed to evaluate the usefulness of laboratory stream ecosystems (microcosms) to study the transport, fate, and effects of toxic substances in natural stream ecosystems. Based upon field studies and classification of natural streams, laboratory streams were designed to model different classes and states of natural streams. Communities in the laboratory streams were exposed to dieldrin, a chlorinated hydrocarbon and fenvalerate, an organophosphate pesticide. Different classes of laboratory streams responded differently to similar exposures. Toxicant dynamics were related to community dynamics through the use of mathematical models and studies of simple laboratory communities in aquaria. These results, along with studies of individual organisms, showed that bioaccumulation coefficients could not be treated as constants. Well-designed laboratory streams and other microcosms are complex dynamic systems that can be used to gain understanding of toxic substance behavior and effects in streams and other ecosystems. But such systems are far too complex and dynamic to be used for bioassays, monitoring, or as predictive tools.

23518 **(PB—87-130951/XAB) Geotechnical analysis for review of dike stability (GARDS). Technical manual. Final report, October 1985-September 1986.** McCandless, R.M.; Bodocsi, A.; Cluxton, P.R. (Cincinnati Univ., OH (USA)). Dec 1986. 171p. NTIS, PC A08/MF A01.

For system on diskette, see PB—87-130969.

The structure and capabilities of a user-friendly, interactive computer program developed for the stability analysis of dikes (GARDS) are described. The program was developed under the sponsorship of the U.S. Environmental Protection Agency and therefore emphasizes Hazardous Waste applications although it is suitable for general use. It is designed to guide regulatory personnel who have a geotechnical background through the customary steps of earth-dike analysis considering slope stability, settlement, liquefaction, hydraulic flow and pressure conditions, and piping. The GARDS software is designed for use on the IBM-PC/XT, PC/AT, or compatible microcomputer. User documentation consists of this Technical Manual which includes program operational procedures, example computer solutions for each analysis, and recommended minimum safety criteria.

23519 **(PB—87-130969/XAB) Geotechnical analysis for dike stability (GARDS) (for microcomputers). Software.** Ammon, D.C.; McCandless, R.; Cluxton, P. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Dec 1986. vp. NTISCP D03.

The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC ST AT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—87-130951.

The structure and capabilities of a user-friendly, interactive computer program developed for the stability analysis of dikes (GARDS) are described. The GARDS program is designed to guide a geotechnical non-specialist (EPA regulatory personnel) through the customary steps of earth dike analysis considering slope stability, settlement, liquefaction, hydraulic flow and pressure conditions, and piping. The GARDS package is designed for use on the IBM-PC/XT microcomputer. User documentation consists of a combined Handbook/User's Manual (under development) which presents basic theory, program operational procedures, and example long hand and computer solutions for each analysis...Software Description: The program is written in the FORTRAN program language for implementation on an IBM-PC AT, XT or compatible microcomputer using a DOS 2.1 or higher operating system. 512K bytes of core storage are required. Note: A hard disk is required; a color monitor is recommended.

23520 **(PB—87-132783/XAB) Borehole sensing methods for ground-water investigations at hazardous-waste sites. Summary report.** Wheatcraft, S.W.; Taylor, K.C.; Hess, J.W.; Morris, T.M. (Nevada Univ., Reno (USA). Desert Research Inst.). Dec 1986. 81p. NTIS, PC A05/MF A01.

Geophysical methods are becoming a cost-effective approach to providing answers to hydrogeologic questions associated with ground-water contamination. Geophysical methods applicable to hazardous-waste-site investigations can be broken into two categories: surface and subsurface methods. Surface methods offer the advantages of relatively little capital investment at the site and rapid collection of data over a horizontal area. Subsurface methods can be used only to investigate an area immediately around the borehole. However, subsurface methods provide excellent information and resolution for vertical changes in measured parameters. The report covers borehole geophysical methods and addresses problems of site characterization, contaminant plume detection and monitoring of contaminant plumes.

23521 **(PB—87-137972/XAB) National data base of nonurban-nonpoint-source discharges and their effect on the nation's water quality. Final report.** Gianessi, L.P.; Peskin, H.M.; Puffer, C.A. (Frost Engineering Development Corp., Denver, CO (USA)). Jul 1986. 310p. NTIS, PC A14/MF A01.

The report summarizes data and procedures used to assemble a National county-based nonurban- nonpoint-source-discharge inventory. The data pertains to five nonurban-nonpoint-source sectors. The inventory estimates discharge of 11 pollutants from these sectors on an average day when runoff occurs throughout the Nation. The report describes integration of the nonurban- nonpoint-source inventory with a national point-source and urban-runoff inventory that also accounts for average daily discharge level of the 11 pollutants. Summary tables show average daily discharges for nonurban-nonpoint, urban-nonpoint, and point-source sectors at the National, State, water-resources region, and producing area levels. The report describes the integration of the nonpoint- and point-source data with the National water-quality model.

23522 **(PB—87-141081/XAB) Case studies and model testing of the Metals Exposure Analysis Modeling System (MEXAMS). Report for January-September 1985.** Medine, A.J.; Bicknell, B.R. (Anderson-Nichols and Co., Inc., Palo Alto, CA (USA)). Dec 1986. 201p. NTIS, PC A10/MF A01.

The Metals Exposure Analysis Modeling System (MEXAMS), linking a complex speciation model with an aquatic transport/fate model, should help discriminate between the fraction of metal that is dissolved and in bioavailable form and the fraction that is complexed and rendered relatively nontoxic. The MEXAMS model was tested with data from three rivers to determine its ability to simulate fate, transport, and speciation of heavy metals in river systems. The rivers selected for study were the Naugatuck River in Connecticut and the Ten Mile River in Massachusetts, both of which receive electroplating and metal finishing wastes, and the White River in Utah, which receives metal loadings from natural sources. The report documents the tests as case studies to guide future users in the application of the model. In addition, the program has been enhanced by addition of sediment settling/resuspension to the aquatic transport submodel EXAMS.

23523 **Linking laboratory and field responses of fish populations to acidification.** Van Winkle, W.; Christensen, S.W.; Breck, J.E. (Oak Ridge National Lab., TN, USA). *Water, Air, and Soil Pollution;* **30**: No. 3-4, 639-648(Oct 1986). (CONF-850944—). Contract AC05-84OR21400.

From Muskoka conference: international symposium on acidic precipitation; Toronto, Ontario, Canada (15 Sep 1985).

To increase understanding of mechanisms by which fish populations respond to water chemistry changes resulting from acidification, it is necessary to link the results of laboratory studies of the effects of pH, Al, and Ca on the survival, growth, and reproduction of individual fish to responses of fish populations in the field. Our framework for achieving this goal is based on the types of data commonly available from both laboratory and field studies. One of the models (PHALCA) in this framework estimates the number of fish surviving as a function of time, given pH, Al, and Ca levels. A second model (FISHEGGS) evaluates the reduction in reproductive potential of a fish population attributable to the effects of pH, Al, and Ca on the survival of young-of-the-year and older fish and on fecundity. Preliminary results from these two models are presented, and the entire framework will be applied and tested over the next year using data for brook trout and lakes in the Adirondacks. The framework and models are a complementary alternative to the statistical analysis of survey data on water chemistry and on presence or absence of a fish species. 14 refs.

23524 **Effect of excluding shredders on leaf litter decomposition in two streams.** Barnes, J.R.; McArthur, J.V.; Cushing, C.E. (Brigham Young Univ., Provo, UT). *Great Basin Naturalist;* **46**: No. 2, 204-207(30 Apr 1986). Contract AC06-76RL01830;AC09-76SR00819.

The effect of excluding shredders on leaf processing rates was studied in a Rocky Mountain stream in Utah and a cold desert stream in Washington. Experimentally excluding shredders significantly decreased the processing rate in both streams. Processing rates (k) were higher in the desert stream, and it is postulated that this is related to increased microbial activity due to the higher water temperatures. 21 references, 2 tables.

23525 **Elemental composition of suspended particles from the Yellow and Yangtze Rivers.** Li, Y.H.; Teraoka, H.; Yang, T.S.; Chen, J.S. (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, NY). *Geochimica et Cosmochimica Acta;* **48**: 1561-1564(1984). Contract AC02-76EV02185.

The elemental composition of suspended particles from the Yellow River is similar to those of the loess terraces and the world's average soils. The contents of Zn, Cu, Ni, Co and Pb in the suspended particles are higher in the Yangtze River than in the Yellow River, indicating pollution inputs or the high-side of natural variability. 14 references, 2 figures, 1 table.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 22280, 22283, 22327, 22348, 22499, 22985, 23453, 23485, 23491

23526 **(DEMO—84/13G) Isotope hydrology study of the Louros riverplain area.** Leontiadis, L. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Dec 1984. 96p. (In Greek). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701506.

The isotopic composition of atmospheric, surface and underground waters has been used in order to investigate the mechanism of recharge of the groundwater of the Louros River basin. The definition of the interconnection of surface and underground waters, as well as the determination of the recharge of the main springs of Louros River and of the plain of Arta are the results of this research. Furthermore the amount of the water recharging Ziros Lake has been calculated and the existence of leakage is pointed out.

23527 **(EUR—10008) Determination of geochemical characters of insterstitial waters of pleistocene Italian clay formations.** Fontanive, A.; Gragnani, R.; Mignuzzi, C.; Spat, G. (Commission of the European Communities, Luxembourg). 1985. 50p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751149.

The geochemical characters of clay formations and of their pore water are fundamental with regards to the mobility of the radionuclides as well as to the corrosion processes on enginered barriers. Experimental researches have been carried out in different types of clay, which represent Italian formations, for the characterization of pore water. A squeezer system, which reaches 1500 Kg/cm^2 in pressure, and an analytical micro-scale methodology, for the determination of dissolved constituents in pore water, were set up. The extracted pore water ranges from 60% to 85% in relation to consolidation state of clay. The chemical composition of the extracted fluid has been checked during the squeezing. During this step the observed variations were smaller than those between the different specimens of the same sample. The comparison between the results obtained by squeezing and by a multiple washing technique, using increasing water/sediment ratios, shows that the last one does not give reliable results on the chemical composition of pore water. This is due to the presence of easily weatherable minerals and to the exchange processes between the clayey minerals and the solution. Nevertheless both these techniques have supplied complementary information about geochemical processes in water-rock interaction. The salinity of pore water ranges from 0.45 g/l to 24.5 g/l and the chemism always shows a high content of calcium-magnesium sulfate, or sodium chloride or calcium-magnesium-sulfate with sodium chloride. The correlation between geochemical composition of pore water and mineralogical composition of clay is not significant.

23528 (IAEA-TECDOC—381, pp 7-44) **Role of tracer methods in hydrology as a source of physical information. Basic concepts and definitions. Time relationship in dynamic systems.** Nir, A. (Weizmann Inst. of Science, Rehovoth, Israel). Jul 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87701515. (CONF-8409389—).

From Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology; Vienna, Austria (17 Sep 1984).

The paper provides a general review on the systems theory approach for the tracer methodology, indicating also the relations of the system theory to other available approaches such as deterministic mechanism description and stochastic approaches. Methodology and formulations of systems approach as applied to tracer use in steady-state cases are discussed. Extension of the systems approach for tracer use in non-steady-state cases and input-output relationships for time varying systems are also given. 39 refs, 4 figs, 4 tabs.

23529 **(INIS-mf—10298) Experimental studies in the radioecology of tritium in Marburg and its surroundings in 1981/1982: Tritium activity in surface, source, rain and drinking water as well as in air humidity.** Frey, B. (Marburg Univ. (Germany, F.R.). Fachbereich Humanmedizin). 26 Jul 1985. 69p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751177.

Between July 1981 and August 1982, 54 surface water samples from 13 spot sampling sites, 14 water samples from 3 sources or wells, 13 drinking-water samples and 63 precipitation samples from Marburg were assayed for their tritium activity. In 6 locations of the Marburg area 20 samples were frozen out of the air humidity and their tritium activity determined. The method used was that of direct liquid scintillation measurements. The lower detection limit was established at 360 pCi/litre. Measurements and calculations yielded the following mean annual values: precipitation: 355 pCi/litre +-31%, surface water: 340 pCi/litre +-33%, source water: 300 pCi/litre +-36%, drinking-water: 230 pCi/litre +-48%.

23530 (INIS-mf—10589, pp 71-72) **Simple mathematical model for radioactivity transport in river-reservoir system.** Plsko, J.; Oravec, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia; Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23531 **(PNL-SA—14263) Ground-water monitoring and modeling at the Hanford Site.** Mitchell, P.J.; Freshley, M.D. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 6p. (CONF-870306—34). NTIS MF A01; 2; GPO Dep. File Number DE87006434.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The ground-water monitoring program at the Hanford Site in southeastern Washington State is continually evolving in response to changing operations at the site, changes in the groundwater flow system, movement of the constituents in the aquifers, and regulatory requirements. Sampling and analysis of ground water, along with ground-water flow and solute transport modeling are used ito evaluate the movement and resulting distributions of radionuclides and hazardous chemical constituents in the unconfined aquifer. Evaluation of monitoring results, modeling, and information on waste management practices are being combined to continually improve the network of ground-water monitoring wells at the site.

5204 Thermal Effluents Monitoring And Transport

23532 **(EPRI-CS—5035) Aqueous discharges from steam-electric power plants: Reference guide for monitoring six selected conventional and nonconventional pollutants: Final report.** Maddalone, R.F.; Moyer, P.W.; Coleman, P.R.; Scott, J.W.; Ackerman, D.G. (TRW Space and Technology Group, Redondo Beach, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1987. 406p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920276.

The objective of this project is to provide the utility industry chemist with a review of the methods currently approved for NPDES monitoring of iron, manganese, ammonia, total residual chlorine (TRC), oil and grease (O and G), and nonfilterable residue (NFR). To accomplish that objective, this report contains a comprehensive review of the precision and bias data and a compilation

of articles from the open literature discussing the determination of conventional and nonconventional pollutants different matrices. In addition to the review of the precision and bias data, this Reference Guide provides a detailed review of sampling and analysis methods for the six parameters studied. Information from standard procedure manuals and open literature sources was compiled and reviewed. These reviews will provide the utility chemist with an in-depth understanding of the problems associated with the analytical methods and the solutions available.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 22311, 23495, 23725

5206 Regulations

REFER ALSO TO CITATION(S) 22662

23533 **(NUREG—1243) Ground-water protection activities of the US Nuclear Regulatory Commission.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Feb 1987. 60p. NTIS, PC A04/MF A01 - GPO. File Number TI87900535.

This report evaluates the internal consistency of NRC's ground-water protection programs. These programs have evolved consistently with growing public concerns about the significance of ground-water contamination and environmental impacts. Early NRC programs provided for protection of the public health and safety by minimizing releases of radionuclides. More recent programs have included provisions for minimizing releases of nonradiological constituents, mitigating environmental impacts, and correcting ground-water contamination. NRC's ground-water protection programs are categorized according to program areas, including nuclear materials and waste management (NMSS), nuclear reactor operation (NRR), confirmatory research and standards development (RES), inspection and enforcement (IE), and agreement state programs (SP). Based on analysis of existing ground-water protection programs within NRC, the interoffice Ground-water Protection Group has identified several inconsistencies between and within program areas. These inconsistencies include: (1) different definitions of the term "ground-water," (2) variable regulation of nonradiological constituents in ground water, (3) different design periods for ground-water protection, and (4) different scopes and rigor of ground-water assessments. The second inconsistency stems from differences in statutory authority granted to the NRC. The third inconsistency is rationalized by recognizing differences in perceived risks associated with nuclear facilities. The Ground-water Protection Group will document its analysis of the remaining inconsistencies and make recommendations to reconcile or eliminate them in a subsequent report.

23534 **(PB—87-137683/XAB) Economic impact of proposed water quality and effluent standard amendments for water in the Sangamon River basin.** Deese, P.L.; Langseth, D. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1986. 218p. NTIS, PC A10/MF A01.

Between 1979 and 1983, the Illinois Environmental Protection Agency (IEPA) conducted a comprehensive review of water-quality standards applicable to the waters of the Sangamon River Basin. The intent of the review was to assess the adequacy of current water-quality standards for protection of existing and potential water uses. Based on these investigations, IEPA made proposals specific to the Sangamon River Basin regarding seven water parameters as addressed in the Illinois Pollution Control Board regulatory docket R83-20. These seven parameters are: iron, manganese, phosphorus, boron, dissolved oxygen, ammonia nitrogen and temperature. The evaluation of anticipated water quality impacts and ramifications for public health and water use presented in this ECIS was based on an independent technical review of the literature, the hearing record, background information provided by the IEPA and other data sources.

53 Social And Economic Studies

REFER ALSO TO CITATION(S) 22652, 22653, 22657, 22679, 23424, 23466, 23492

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 22663, 22688, 23427, 23466, 23495

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 23716

5502 Biochemistry

REFER ALSO TO CITATION(S) 22354, 22355, 22364, 22366, 22368, 22987, 23086, 23118, 23127, 23559, 23653, 23691, 23693, 23712

23535 **(BNL—39310) Chromosomal replicons of higher plants.** Van't Hof, J. (Brookhaven National Lab., Upton, NY (USA)). 16 Mar 1987. Contract AC02-76CH00016. 15p. (CONF-870393—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87006915.

From 18. Stadler genetics symposium: chromosome structure and function: the impact of new concepts; Columbia, MO, USA (16 Mar 1987).

This brief discussion of replicons of higher plants offers a glimpse into the properties of chromosomal DNA replication. It gives evidence that the S phase of unrelated plant species is comprised of temporally ordered replicon families that increase in number with genome size. This orderly process, which assures a normal inheritance of genetic material to recipient daughter cells, is maintained at the level of replicon clusters by two mutually exclusive mechanisms, one involving the rate at which single replicons replicate their allotment of DNA, and another by means of the tempo-pause. The same two mechanisms are used by cells to alter the pattern of chromosomal DNA replication just prior to and during normal development. Both mechanisms are genetically determined and produce genetic effects when disturbed of disrupted by additional non-conforming DNAs. Further insight into how these two mechanisms operate requires more molecular information about the nature of replicons and the factors that govern when a replicon family replicates. Plant material is a rich and ideal source for this information just awaiting exploitation. 63 refs.

23536 **(DOE/ER/13241—1) [Genetics of the methanogenic bacterium Methanococcus voltae with attention to genetic control mechanisms]: Progress report.** (Illinois Univ., Urbana (USA). Dept. of Microbiology). [1986]. Contract FG02-84ER13241. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007064.

The development of methanogen plasmid gene vectors would be greatly expedited by knowledge of the structure of methanogen transcription and translation signals. This would allow the directed insertion of a gene of choice downstream of the appropriate DNA sequences so as to bring about expression of that gene in the methanogen. The cloning of a Mc. voltae gene which complemented a hisA mutation in both E. coli and S. typhimurium has been reported. Characterization of the cloned gene indicated that both transcription and translation of the methanogen gene were initiated on the cloned methanogen DNA fragment. The methanogen hisA gene was sequenced and its sequence compared to a hisA-complementing gene isolated from Mc. vannielii. These studies demonstrated that each of these genes contained a eubacterial-like ribosome binding site (G-G-T-G) immediately upstream of the translation initiation codon which strongly suggests that methanogen messenger RNA can be recognized and translated by E. coli ribosomes and, perhaps, vice versa. 5 refs.

23537 (INIS-mf—10578, pp O15) **Colony hybridization with synthetic biotinylated and /sup 32/P-labelled DNA probes for the detection of Escherichia Coli ST and LT genes.** Greeff, A.S.; Geyer, A. (Medical University of Southern Africa, Pretoria, South Africa. Dept. of Microbiology). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23538 (INIS-mf—10578, pp P78) **Enzymic preparation of (γ-/sup 32/P)ATP, (α-/sup 32/P)dGTP and (α-/sup 32/P) GTP.** Warren, R.; White, D.; Rees, J.S.; Retief, J.D.; Von Holt, C. (Cape Town Univ., South Africa. Dept. of Biochemistry). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23539 (INIS-mf—10578, pp P88) **Fast turnover of core histones in active chromatin.** Schwager, S.; Murray, E.; Von Holt, C. (Cape Town Univ., South Africa. Dept. of Biochemistry). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23540 (INIS-mf—10578, pp P270) **Effect of MSH on tyrosinase activity of mouse skin explants.** Gatsios, H.; Kidson, S.H. (University of the Witwatersrand, Johannesburg, South Africa. Dept. of Zoology; Cape Town Univ., South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23541 (INIS-mf—10578, pp P282) **Biosynthesis of apoliprotein B in isolated rat enterocytes.** Gevers, W.; Getz, G.S.; Sherman, H. (Cape Town Univ., South Africa; Chicago Univ., IL, USA. Dept. of Pathology). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23542 **(INIS-mf—10578) First joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology at the University of the Witwatersrand, 29 June-4 July 1986.** (University of the Witwatersrand, Johannesburg (South Africa)). 1986. 503p. (CONF-8606256—). NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106.

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

Items within the scope of EDB have been entered individually into the data base. (ACR)

23543 (ORNL—6353, pp 4-9) **Molecular mutagenesis and protein engineering.** Hartman, F.C.; Larimer, F.W.; Mitra, S.; Mural, R.J.; Niyogi, S.K.; Soper, T.; Stevens, A.; Foote, R.S.; Lee, E.H.; Engler, D.A.; Machanoff, R. . Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

This program evaluates the use of site-directed mutagenesis to elucidate mechanisms of protein function and the develops methods to facilitate applications of site-directed mutagenesis. Currently, the authors are addressing structure/function correlations of three proteins: ribulose bisphosphate carboxylase, DNA-O^6-methylguanine methyltransferase, and epidermal growth factor.

23544 (ORNL—6353, pp 9-13) **Protein chemistry and enzyme mechanisms.** Hartman, F.C.; Lee, E.H.; Milanez, S.; Porter, M.A.; Smith, H.B.; Stringer, C.D. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Since virtually all biological processes are enzyme mediated, studies of enzyme structure and function are clearly central to a broad-based program concerning health effects of environmental agents. The authors efforts are focused on active-site characterization which bears directly on the elucidation of the principles underlying two key properties of enzymes: their stringent specificity and their enormous catalytic efficiency. The most versatile approach for the selective introduction of a chemical label into the active site, thereby providing structure/function correlations and identifications of active-site residues, is affinity labeling. In its traditional form, affinity labeling entails the use of reactive analogs of natural substrates to label substrate binding sites. The substrate-like features of the reagent direct it to the active site in a fashion completely analogous to the binding of competitive inhibitors. This binding step results in a localized high concentration of reagent within the substrate binding site and thus increases the likelihood of modification of a residue within this site as compared to other positions of the protein molecule. Many of recent investigations have centered on two Calvin cycle enzymes that are major determinants of plant growth and yield: ribulose bisphosphate carboxylase and phosphoribulokinase. 8 references.

23545 (ORNL—6353, pp 28-31) **Studies of RNA processing and turnover and EGF stimulation of transcription.** Stevens, A.S.; Engler, D.A.; Matsunami, R.; Maupin, M.K. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In the last ten years, it has become apparent that the transcription process does not produce mature RNA molecules. Precursors of tRNA, rRNA, and mRNA are produced with extra nucleotide sequences at both the 5′ and 3′ ends and with extra sequences (introns) in the middle of the RNA. Trimming of RNA molecules at both ends as well as splicing to remove introns must occur before the final mature RNA is produced. Turnover of RNA is also a vital reaction in cells. mRNA molecules undergo turnover in order to to modulate their levels and their respective protein products. Removal of RNA primers from the 5′-end of DNA strands during DNA replication occurs, and introns and other RNA extra sequences must be degraded. RNases are the key enzymes involved in both the maturation and turnover reactions. The integrity of each cell is dependent on it having the proper array of RNA molecules. Any environmental agent that interferes with the maturation or turnover reactions may be very deleterious to the cell. Studies of RNases and their possible involvement in processing and turnover of RNA continue in this laboratory.

23546 (ORNL—6353, pp 31-32) **Molecular studies of transcription by eukaryotic RNA polymerase II.** Niyogi, S.K.; Engler, D.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The elucidation of molecular mechanisms of accurate transcription initiation by eukaryotic RNA polymerase II requires knowledge of the properties of the enzyme, the DNA regions that serve as transcription control signals, and the protein factors that mediate correct initiation through their interaction with these DNA signals and/or the RNA polymerase II enzyme. The authors, along with other investigators, have studied the nature of the protein factors and their interaction with the template DNA. During the last year, they turned their attention to the molecular structure of RNA polymerase II, a protein composed of different subunits, in an effort to determine the sites on the enzyme that are targets for physiological modifications, e.g., phosphorylation, and for interaction with possible transcription specificity factors.

23547 (ORNL—6353, pp 32-35) **Structure and organization of the eukaryotic genome with special emphasis on satellite DNAs and the phenomenology of the crustacean molt cycle.** Skinner, D.M.; Biesiot, P.M.; Fowler, R.F.; O'Brien, J.J.; Paulson, C.R.; Stringfellow, L.A.; Wang, S.Y. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors are working with a model system to characterize hotspots for mutations in the eukaryotic genome. The model system is a very complex satellite DNA of a land crab Gecarcinus lateralis. They have selected this system because of the unusual characteristics of the subject DNA coupled with the biology of the animal, which has a cyclic pattern of growth and can regenerate appendages. The satellite has an average repeat unit of 2.1 kilobase pairs and is characterized by domains that are highly conserved among individual copies of the satellite. The primary sequence of these domains is not remarkable in either base composition or arrangement. These conserved domains are interspersed with domains that are hypervariable, undergoing deletions as large as 108 base pairs. The hypervariable domains are characterized by unusual sequences. These sequences are either highly repeated ones that can adopt altered secondary or tertiary structures or alternating purines and pyrimidines that have the potential for adopting a Z-conformation.

23548 (ORNL—6353, pp 35-37) **Chromosome chemistry.** Olins, D.E.; Olins, A.L.; Bast, M.H.; Barwick, J.; Cacheiro, L.H.; Finch, J.H.; Herrmann, A.L.; Roberson, A.E. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The major goal of this laboratory is to analyze and understand the macromolecular structure of eukaryotic chromosomes. This macromolecular structure is intimately involved in the three major functions of chromosomes: DNA packaging, transcription, and replication. Any of these functions can be damaged by exposure to abnormal physical or chemical agents. The authors laboratory employs a wide range of biophysical, biochemical and ultrastructural techniques to work towards detailed macromolecular models. During the past year the authors laboratory has concentrated its efforts in two major directions: (1) chromatin structure in the hypotrichous ciliated protozoa, and (2) 3-D reconstruction of a transcriptionally-active gene by electron microscope topography.

23549 (ORNL—6353, pp 38-40) **Nucleosome and chromatin biophysics.** Bunick, G.J.; Uberbacher, E.C.; Harp, J.M. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The goal of this study to analyze and structure and function of the key macromolecular components of genetic material. The macromolecular components under investigation are involved in the major functions of chromatin: DNA packaging, regulation and transcription, and replication. It is the authors intent to define the role these macromolecules play in facilitating these processes and how exposure to mutagenic or carcinogenic environmental agents may affect necessary genetic functions. Their approach is to use a number of biophysical and biochemical techniques to provide detailed structural models of these important macromolecules. They have concentrated their effort in two major directions: (1) X-ray crystallography of avian erythrocyte mononucleosomes; (2) small-angle neutron scattering studies of nucleosomes, HMG-nucleosome complexes, nucleosome oligomers, and related materials.

23550 (ORNL—6353, pp 99-101) **Investigation of the process of X inactivation through analysis of OTC activity in X-autosome translocations.** Russell, L.B.; Jacobson, K.B.; Cacheiro, N.L.A.; Johnson, D.K.; Klebig, M.L.; Montgomery, C.S.; Maddux, S.C. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Though the single-active-X-chromosome hypothesis is now 25 years old, the question of how any signal for activity/inactivity received by an X comes to affect an entire chromosome is still unresolved. X-autosome translocations [T(X;A)s] provide potentially excellent tools for an approach to this problem, since the rearrangement has distributed the X to two different chromosomes, the X/ sup A/ and the A/sup X/ (where A is any autosome). In studying XX/sup A/A/sup X/A females, the question can be asked whether, in those cells in which the intact X is active, both X/sup A/ and A/sup X/ are inactive or only one (or part of one). For all T(X;A)s, except R2, all meaningful evidence on in activation vs noninactivation is confined to that translocation product (X/sup A/ or A/sup X/, in different cases) that includes the R2-R6 region of the X. In R2, evidence is, in addition, available for the reciprocal chromosome. This evidence was based on studies with three autosomal (Chromosome 7) loci, (c, Mod-2, and sh-1), all of which were shown not to be subject of inactivation. It was of interest, therefore, to obtain evidence also on an X-linked locus in that chromosome, as well as on other T(X;A)s. The locus chosen was sparse-fur, spf, the wild-type allele of which codes for ornithine transcarbamoylase, OTC an enzyme whose activity can be readily quantitated.

23551 (ORNL—6353, pp 132-134) **Monoclonal antibodies for diagnosis and therapy.** Kennel, S.J.; Epler, R.G.; Foote, L.J.; Hotchkiss, J.A.; Lankford, P.K. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

A tumor surface protein of 180,000 Mr (TSP-180) has been identified on cells of several lung and mammary carcinomas of BALB/c mice. TSP-180 was not detected on normal lung tissue, embryonic tissue, or reticulum cell or other sarcomas, but it was found on lung carcinomas and a melanoma from other strains of mice. Considerably amino acid sequence homology exists among TSP-180s from several cell sources, indicating that TSP-180 synthesis is directed by normal cellular gene(s) although it is not expressed at high levels in normal cells. The regulation of synthesis of TSP-180 and its relationship to normal cell surface proteins are being studied with the hypothesis that it may represent a receptor molecule for growth regulation factors. Monoclonal antibodies (MoAb) to TSP-180 have been developed. The antibodies have been used in immunoaffinity chromatography to isolate TSP-180 from tumor cell sources. This purified tumor antigen was used to immunize rats. Antibody produced by these animals reacted at different sites (epitopes) on the TSP-180 molecule from those with the original MoAb. Two MoAbs were used to develop a two site assay for TSP-180. This assay allows quantitation of low levels (ngs/mg protein) of TSP-180 in normal and neoplastic tissue. Results indicate that tumors have 10-100 times more TSP-180 than do normal tissue.

23552 **Chromopeptides from phycoerythrocyanin. Structure and linkage of the three bilin groups.** Bishop, J.E.; Rapoport, H.; Klotz, A.V.; Chan, C.F.; Glazer, A.N.; Fueglistaller, P.; Zuber, H. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 3, 875-881(1987).

Phycoerythrocyanin carries two covalently attached phycocyanobilin (PCB) groups on the β subunit and a phycobiliviolinoid (PXB) group on the α subunit. Three distinct bilipeptides were obtained by proteolytic digestion of this protein: Asn-Gln-Ala-Ala-Cys(PCB)-Ile-Arg, Gly-Asp-Cys(PCB)-Ser-Gln, and Cys(PXB)-Val-Arg. Correlation 500-MHz ^{1}H NMR analyses showed that the heptapeptide and pentapeptide were attached by cysteinyl thioether linkage to the A ring of the PCB moiety. ^{1}H NMR and mass spectrometry determinations led to structural assignment for the hitherto uncharacterized PXB moiety, with peptide-thioether bonding possible to either ring A or D. Amino acid sequence homologies strongly favor A-ring linkage.

23553 **Davydov solitons exist at 300 K.** Lomdahl, P.S.; Kerr, W.C. (Los Alamos National Lab., NM). *Physical Review Letters;* **55**: No. 11, 1235-1238(9 Sep 1985).

The Davydov model for a one-dimensional protein, coupling the high-frequency amide-I vibration to longitudinal-acoustic phonons, is investigated by use of finite-temperature molecular dynamics. Soliton dynamics is studied in both equilibrium and nonequilibrium situations. The random thermal motions prevent self-trapping

from occurring at temperatures of interest for transport in real proteins. 9 references, 2 figures, 1 table.

23554 **Use of nearly neat $^{16}O^{18}O$ in spectroscopic studies of oxyhemerythrin and oxyhemoglobin.** Appelman, E.H. (Argonne National Lab., IL). *Accounts of Chemical Research;* **18**: No. 1, 2(Jan 1985). Contract W-31-109-ENG-38.

Klotz and Kurtz mention the use of nearly neat $^{16}O^{18}O$ in a resonance Raman spectroscopic study of the bonding of O_2 in oxyhemerythyrin, citing unpublished work in a dissertation in their work on hemerythrin. A prior study of the O_2 bonding in oxyhemoglobin was carried out with the same ^{1}&$O^{18}O$ sample, and led to a similar conclusion, i.e., that the O_2 was bonded in such a way that the two oxygen atoms were not equivalent. To the best of the authors knowledge, this work constituted the first preparation of neat $^{16}O^{18}O$ and its first use in spectroscopy. The work represents a collaboration between the group at Northwestern and a group at Argonne National Laboratory, where the $^{16}O^{18}O$ was prepared by a rather laborious procedure that entailed the intermediate synthesis of ^{18}O-enriched hypofluorous acid. A more convenient synthesis of nearly neat $^{16}O^{18}O$ that makes use of the recently isolated fluoroxysulfate ion, SO_4F^- was subsequently developed, and it is anticipated that this uniquely labeled oxygen molecule will now find application in a variety of spectroscopic measurements.

23555 **Changes in histone H1 content and chromatin structure of cells blocked in early S phase by 5-fluorodeoxyuridine and aphidicolin.** D'Anna, J.A.; Tobey, R.A. (Los Alamos National Lab., NM). *Biochemistry;* **23**: No. 21, 5024-5029(1984).

The authors have measured changes in histone H1 content and changes in chromatin structure of Chinese hamster (line CHO) cells blocked in early S phase by sequential use of isoleucine deprivation and blockade with 5-fluorodeoxyuridine or aphidicolin. Both the H1:core histone ratio in isolated nuclei and the H1 content of the cell are reduced 20-60%, depending on the duration of the block. The new deoxyribonucleic acid synthesized during S-phase block has a shorter nucleosome repeat length than that of bulk chromatin, but it is nearly equally resistant as bulk DNA to attack by micrococcal nuclease. During the time that H1 content is decreasing, bulk chromatin also undergoes structural changes so that its nucleosome cores appear to be more closely packed along the DNA chain. The losses in H1 content and changes in chromatin structure are similar to those reported for cells blocked in early S phase by hydroxyurea. The results suggest that losses of H1 and changes in chromatin structure are general events which occur when the elongation of initiated replicons or the joining of intermediate-sized DNA fragments is retarded during replication. They are consistent with the notions that (1) H1 is lost from initiated replicons and/or (2) the loss of H1 is part of an alarm response in the cell which might facilitate events leading to gene amplification. 39 references, 5 figures, 3 tables.

23556 **Chemiosmotic model for plant mitochondria.** Elthon, T.E.; Stewart C.R. (Iowa State Univ., Ames). *BioScience;* **33**: No. 11, 687-692(Dec 1983). Contract AC02-82ER12028.

A balanced application of chemiosmosis to plant mitochondria is presented. Electron transport carriers are sequenced to achieve proton translocation across the inner membrane. The processes of proton translocation, use, and release are integrated to yield a description of the effective proton gradient available for metabolite transport and ATP synthesis. 27 references, 6 figures.

5503 Cytology

REFER ALSO TO CITATION(S) 22365, 23573, 23616, 23618

23557 **(DOE/ER/10700—T3) Fluorescence photobleaching measurements of plant membrane viscosity: Effects of environmental stress: Final report.** Breidenbach, R.W. (California Univ., Davis (USA). Plant Growth Lab.). Nov 1986. Contract AT03-80ER10700. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007534.

The primary purpose of this project was to measure the temperature dependence of the fluidity of plant cell membranes by fluorescence photobleaching recovery, and see if there is a change in fluidity at the temperature of chilling injury. For practical reasons, we have concentrated on measurements of the lateral diffusion constant of the lipid analog dil in tomato vacuolar membrane. We have found an apparent change in the diffusion constant of dil near the temperature of chilling injury ($\sim 12^{\circ}C$), but the scatter in the diffusion constants makes it difficult to prove that there is a change. 11 refs.

23558 (INIS-mf—10578, pp P281) **Interaction of normal and SAA-containing HDL with fibroblasts.** Jeenah, M.S.; Coetzee, G.A.; Van der Westhuyzen, D.R.; De Beer, F.C. (Cape Town Univ., South Africa; Stellenbosch Univ., South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

5504 Genetics

REFER ALSO TO CITATION(S) 22372, 23537, 23539, 23542, 23550, 23659, 23693, 23704

23559 (INIS-mf—10578, pp O47A) **Some answers to the mechanism of C-banding.** Motara, M.A. (Durban-Westville Univ., South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23560 (ORNL—6353, pp 27-28) **Genetic control of mutagenesis and DNA repair.** Larimer, F.W.; Hardigree, A.A.; Perry, J.R. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In the yeast Saccharomyces cerevisiae, three major epistasis groups of genes controlling the processing of DNA damage have been recognized: the RAD52 group is required for the repair of double-strand breaks in DNA via a post-replication repair process; the RAD3 group directs excision-repair of pyrimidine dimers and other bulky lesions; the RAD6 group is required for a second form of post-replication repair and is responsible for nearly all induced mutagenesis. In recent years the RAD6 epistasis group has occupied the authors interest, in particular those mutants such as rev1 and rev2 which have allele-specific and mutagen-specific effects on mutability. Several lines of evidence suggest that these are mutants of structural genes involved in misrepair mutagenesis. The authors have sought to clone the REV genes to facilitate 1) the study of their regulation, and 2) the identification of their gene products.

23561 (ORNL—6353, pp 44-50) **Mammalian cytogenetics.** Preston, R.J.; Gooch, P.C.; Ho, T.; Luippold, H.E.; Payne, H.S.; Bast, C.B.; Greer, G.A.; Hook, G.J.; Horesovsky, G.J.; Winegar, R.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The Mammalian Cytogenetics Group has continued with its basic program to determine the mechanism of induction of chromosomal alterations in human and other mammalian cells (in vivo and in vitro), and in particular to understand how non-random chromosome changes can be produced. In addition, the consequences of the induction of non-random (i.e., specific) chromosome aberrations in terms of the production of genetic defects and cancer are being studied. Several mouse tumor models are being utilized for studying whether or not particular chromosome aberrations are involved in the initiation or progression of neoplasia, and whether there are progressive chromosomal changes during the development of tumors that are specific for different inducing agents. They have also recently begun several projects that are designed to study

chromosome aberration and mutation induction by radiation and chemical agent at the molecular level.

23562 (ORNL—6353, pp 57-61) **Genetics of anaerobic organisms.** Adler, H.I.; Crow, W.D.; Billen, D.; Jamison, S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors have been involved in studying degeneration clostridium acetobutylicum by observing the rapid genetic changes that take place spontaneously in cultures of this organism. These changes can be recognized and studied by isolating the cells from morphologically distinct regions of colonies of the parental wild type. The isolates have been characterized with regard to their growth rates, ability to form spores, ability to produce solvents, cell morphology and colony morphology. The authors have also been studying the characterization of oxygen sensitive Escherichia coli by observing mutants that have been isolated after exposure to ultraviolet light. These mutants, incubated aerobically, will not form colonies on agar medium containing glucose. However, they do form colonies anaerobically. These studies have revealed some unique features of the bacterial response to oxygen. The indirect action of ionizing radiation as the primary cause of potentially lethal damage and its repair was investigated. The radiosensitivity of rec-type E. coli mutants, deficient both in recombinational repair and induced-error prone repair, was measured in the presence of OH radical scavengers.

23563 (ORNL—6353, pp 90) **Effect of dilute-suppressor on combinations of dilute-lethal mutations.** Russell, L.B.; Montgomery, C.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The only recessive suppressor mutation known in any mammal is dilute-suppressor (dsu). This gene is located on Chromosome 1 and thus unlinked to dilute (d) on Chromosome 9. The authors have undertaken a study to determine the effect of dsu on complementing and non-complementing combinations of d deletions in mice. For this purpose, it was necessary for the authors, first, to construct a stock that was dsu/dsu; d se/d se. They have now made over a dozen crosses of the type d/sup pl1/ +/d se; +/dsu x d/sup pl2/ +/dse; +/dsu, where d/sup pl1/ and d/sup pl2/ represent any two different d/sup pl/ (prenatally-lethal dilute) mutations. In the absence of dsu, they have earlier shown some of these d/sup pl1//d/sup pl2/ combinations to be prenatally lethal, while others produce a dilute-opisthotonic phenotype. In the presence of dsu/dsu, some combinations in the latter class now appear to be non-dilute opisthotonic, i.e., the pigment phenotype has been suppressed. There is, to date, no evidence that dsu/dsu can suppress opisthotonus or lethality.

23564 (ORNL—6353, pp 92-93) **Genetic mapping in mouse Chromosome 7, using meiotic recombination data for RFLPs; comparison with human 11p.** Albritton, L.M.; Russell, L.B.; Montgomery, C.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

One method explored for localization of DNA sequences to c-locus deletions involved crossing some of these deletions to Mus spretus. Male progeny from such crosses is invariably sterile, but female progeny was crossed to a c/sup ch//c/sup ch/ stock, or to C57BL/10, to generate meiotic recombination data for RFLPs. Altogether 44 backcross offspring were studied to analyze five previously unmapped Chromosome-7 sequences for which RFLPs had been identified by the authors, as well as three sequences and one phenotypic marker (c/sup ch/) that have earlier been mapped to specific loci on Ch 7. The most probable gene order was inferred by arranging the sequences in all possible permutations and determining which order would minimize the number of double crossovers that would have to be postulated. The following order requires no doubles: Centromere - Ldh-1 - Hras-1 - c - 12A - Hbb - (Ct,Pth) - CLX18 - H19. This makes possible the following gene-order comparison for mouse Chromosome 7 and human 11p. Mouse 7: Ldh-1 - Hras-1 - Hbb - Ct, Pth. Human 11p: LDHA - CALC1 - PTH - HBBC - HRAS1 (corresponding loci are Ldh-1 and LDHA; Hras-1 and HRAS1; Hbb and HBBC; Ct and CALC1; Pth and PTH). This comparison suggests that a minimum of one arrangement has occurred between the two species in the region defined by these 5 loci.

23565 (ORNL—6353, pp 102-103) **Synaptic behavior of a new translocation T(X;7)18Rl and the hypothesis of G-synapsis.** Ashley, T.; Russell, L.B.; Cacheiro, N.L.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The synaptic behavior of T(X;7)18Rl (R18) has been studied by synaptonemal complex analysis of spermatocytes from translocation heterozygotes. A small amount of nonhomologous synapsis was observed. Varying degrees of nonhomologous synapsis had been found by the authors in some, but not all, X-autosome translocations they have studied. The R18 results led them to reexamine each of these other translocations in an attempt to determine whether degrees of nonhomologous pairing might be correlated with any variables. They made the discovery that those translocations that have both breaks in G-light bands exhibit only homologous synapsis during early meiotic prophase, while those translocations that have one or both breaks in a G-dark band exhibit varying degrees of nonhomologous synapsis. These observations have led them to suggest that if a translocation has meiotically aligned nonhomologous sequences, G-light chromatin has the ability to recognize homology during zygotene and to cease synapsis. However, if a translocation has meiotically aligned G-dark chromatin with G-light chromatin, the G-dark chromatin does not recognize lack of homology and continues synapsis. They have termed this type of nonhomologous synapsis G-synapsis.

23566 (ORNL—6353, pp 103) **Relation of non-homologous synapsis found in synaptonemal complexes of T(X;4)1Rl mice to location of the translocation breakpoints.** Ashley, T.; Russell, L.B. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The synaptonemal complexes of T(X;4)1Rl (R1) translocation heterozygotes have been examined by electron microscopy and compared with those of two X-7 translocations: R5 and R6. The X-chromosome breakpoint of R1 is estimated to lie between 78 and 82% from the proximal end of the X, in the same general regions as the R5 and R6 breakpoints. The position of the autosomal breakpoint of R1, like that of R6, is about 30% from the centromeric end of the respective autosome, the R5 breakpoint is slightly more proximal. Despite these general similarities between the three translocations, there are differences in synaptic behavior. In R1 and R6, there is extensive nonhomologous synapsis, both in quadrivalents and in heteromorphic bivalents, while in R5, all synapsis is confined to homology. The translocations also differ in the location of breakpoints relative to the position of the G-bands. Thus, in R5, both breaks of the reciprocal translocation lie in G-light bands, and synapsis is strictly homologous. In R1 and R6, at least one break lies in or immediately adjacent to a G-dark band, and there is nonhomologous synapsis. Comparison of the synaptic behaviors also leads to the conclusion that G-band-related nonhomologous synapsis is different from the synaptic adjustment phenomenon previously described by Moses. The G-band-related nonhomologous synapsis is not substage specific, but competes with homologous synapsis during zygotene-early pachytene.

23567 (ORNL—6353, pp 104) **Excessive nonhomologous synapsis in T(X;16)16H heterozygous male mice suggest a trans-chromosomal effect of G-dark breaks.** Ashley, T. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In examining the pairing behavior of male mice heterozygous for the T(X;16)16H translocation by synaptonemal complex analysis, extensive nonhomologous synapsis was observed (involving 38% of chromosome 16). One of the translocation breakpoints is located in the very distal portion of band XD, on the border of XE, a G-dark band; therefore, on the basis of the hypothesis sum-

marized above, some nonhomologous synapsis was expected. However, the amount actually observed was considerably greater than anticipated. It may be suggested that nonhomologous synapsis of the G-dark chromatin in band XE (on the X chromosome) with G-light chromatin on chromosome 16 proceeded into the G-dark band 16C3 (on chromosome 16) and triggered a second round of nonhomologous synapsis of the dark 16C3 band with G-light chromatin on the X. The data suggest that nonhomologous G-synapsis, triggered by a G-dark-band break in one of the translocated chromosomes, can cascade from one chromosome to another with which it is meiotically paired.

23568 (ORNL—6353, pp 104-105) **RNA synthesis in spermatocytes of sterile X-autosome translocation males.** Ashley, T.; Russell, L.B. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

All X-autosome translocations studied to date produce sterility in male heterozygotes, with spermatogenesis ceasing in pachytene. It has been suggested that this sterility is caused by the reactivation of X-chromosomal material by the contiguous autosomal segments. Thus, reactivated X transcription could result in translation of a nonpermissible gene product in the spermatocytes. Testing of this hypothesis requires a high-resolution technique that can distinguish X-chromosomal from autosomal portions of the translocated chromosomes with regard to ^{3}H-uridine incorporation. The microspreading technique routinely used for electron microscopic analysis of synaptonemal complexes does not preserve the chromatin in sufficient quantity for study. They have been able to modify the technique so as to increase the retention of chromatin. They can now demonstrate ^{3}H-uridine incorporation in the autosomes and little incorporation in the sex chromosomes of nontranslocation mice. Although the technique still requires modifications, it is already evident that it will provide sufficient resolution to distinguish between incorporation over the X and autosomal portions of translocation chromosomes.

23569 (ORNL—6353, pp 112-116) **Molecular genetics of carcinogenesis.** Yang, W.K.; Brown, A.; Ch'ang, L.Y.; Furkes, R.; Gardner, M.; Koh, C.K.; Kuemmerle, N.; Myer, F.E.; Nikbakht, K.N.; Yang, D.M. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Two aspects are considered to be of importance on the molecular genetic mechanisms of carcinogenesis. One is the gene rearrangement event frequently observed in neoplastic cells and the other is the genetic control of neoplastic phenotype expression initiated by an oncogene alteration. To investigate the first aspect, the authors working hypothesis is that the genomic instability of neoplastic cells is associated with the activation of mobile gene elements in the cell genome; and the subject of their experimental work is the retrotransposable genes inherited in the germ line of the mouse. To investigate the second aspect, their initial efforts have been to develop an in vitro cell system for demonstrating the dominant control of neoplastic phenotype expression involving ras oncogenes. In the past year, progress has been made mainly on molecular and functional characterization of murine leukemia virus-related (MuLV-related) proviral sequences and MboI-repeat LTR-containing (MRL) elements isolated from mouse chromosomal DNA and also on exploiting the DNA transfection approach for the detection of controlling factor(s) of neoplastic phenotype expression.

23570 (ORNL—6353, pp 116-119) **Regulation of gene expression.** Kenney, F.T.; Lee, K.L.; Cadilla, C.L.; Holloway, G.R.; Isham, K.R. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The objectives of this research are to define in molecular terms the mechanisms controlling expression of specific genes in mammalian cells, how these mechanisms operate during differentiation, and how they are regulated by hormones and other specific effectors. They focus primarily on liver and on genes that are both developmentally and hormonally regulated in that tissue. During this year they have also worked toward development of a general assay for mutations of the deletion or translocation type, by direct analysis of DNA. Significant progress has been made in a number of experimental approaches.

23571 **Polymorphism in the ribosomal RNA genes in three heterothallic species of Neurospora.** Chambers, C.; Crouch, R.J.; Dutta, S.K. (Howard Univ., Washington, DC). *Genetics;* **107**: No. 3, vp(1984).

The authors have studied differences in molecular structures of ribosomal RNA genes (rDNAs) from different heterothallic species of Neurospora: N. crassa, N. intermedia and N. sitophila to detect any possible differences in rDNA sequences of these three species. The authors have made a new clone (named by us as pCC3400) which contains 3250 bps of the external spacer region of N. crassa wild type strain 74A rDNA sequences. This should contain both the promoter and termination regulatory sites for transcription of rRNA. Using this probe the authors have identified that about 300 bp sequences of the external spacer region present in N. crassa are apparently deleted in the species N. intermedia and N. sitophila, based on restriction patterns of 12 different enzymes. Also new restriction sites were determined as a result of the DNA sequencing of the entire ITS (internal transcribed spacer) region of the pMF2 N. crassa rDNA clone. These results were used to look at differences in the ITS regions. In addition the authors have identified a Sma 1 site within 26S rDNA which is deleted from N. intermedia but present in both N. sitophila and N. crassa. An Nru 1 site was detected in the NTES regions of N. sitophila and of N. intermedia which was not present in that position in N. crassa. All of these studies clearly establish polymorphism of Neurospora rRNA genes.

5505 Metabolism

REFER ALSO TO CITATION(S) 22366, 22368, 22376, 23539, 23558, 23640, 23690, 23695, 23696, 23698, 23703, 23705, 23708, 23709, 23710

23572 (INIS-mf—10578, pp P187) **Dietary manipulation alters the release of acetylcholine from rat striatum.** Kurstjens, N.P.; Cantrill, R.C. (University of the Witwatersrand, Johannesburg, South Africa. Medical School). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23573 (INIS-mf—10578, pp P174) **Preferential uptake of core lipids of HDL/sub 3/ by HEP G2 cells.** Hendricks, D.H.; Coetzee, G.A.; Gevers, W.; Van der Westhuyzen, D.R. (Cape Town Univ., South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23574 **Steady state proline levels in salt-shocked barley leaves.** Voetberg, G.; Stewart, C.R. (Iowa State Univ., Ames). *Plant Physiology;* **76**: 567-570(1984). Contract AC02-82ER12028.

Excised barley leaves were treated with salt solutions or wilted. After the treatment period, the leaves were allowed to recover in a 50 millimolar sucrose and 1 millimolar glutamate solution, and proline, Na^+, and K^+ were measured at intervals. Na^+ and K^+ concentrations stayed at a constant high level after the salt treatments, and proline increased to a steady state concentration in response. the relationship between the maximum rate of proline accumulation and the Na^+ concentration reached in each experiment was linear. The final steady state proline concentration reached was also directly proportional to the Na^+ concentration. For a given Na^+ concentration in the leaves, the steady state proline level was greater when 410 millimolar NaCl was added to the leaves than when 205 millimolar NaCl was added. These results are consistent with proline acting as a compatible cytoplasmic solute, balancing an accumulation of salts outside of the cytoplasm. In contrast to the

proline levels in salt-shocked leaves, the concentrations in wilted leaves decreased to near control levels within 24 hours of relief of stress. 20 references, 4 figures.

23575 **Effects of NaCl on proline synthesis and utilization in excised barley leaves.** Buhl, M.B.; Stewart, C.R. (Iowa State Univ., Ames). *Plant Physiology;* 72: 664-667(1983). Contract AC02-82ER12028.

Proline accumulation in NaCl-treated excised barley leaves was studied. Leaves were treated by placing the cut end in NaCl solutions and allowing the salt to enter the leaf via the transpiration stream. Leaves treated this way maintained turgor while the sodium content increased and the osmotic potential decreased. Proline began accumulating after 12 hours and continued accumulating over the subsequent 12-hour period at an average rate of 0.6 micromoles per hour per gram fresh weight. During the time proline was accumulating, (^{14}C)glutamate was added to measure the effects of salt on proline synthesis from glutamate and (^{14}C)proline was added in separate experiments to determine the effect of salt on proline utilization. Salt treatment dramatically increased proline synthesis from glutamate. Proline utilization by oxidation and for protein synthesis was decreased by 50 and 60%, respectively, by the salt treatment. These effects are similar to the effects of drought and abscisic acid in barley leaves. The results indicate that common mechanisms cause proline to accumulate under these different stresses. 12 references, 5 figures. 1 table.

5506 Medicine

REFER ALSO TO CITATION(S) 22345, 22346, 23173, 23256, 23257, 23258, 23259, 23260, 23275, 23340, 23392, 23643, 23673

23576 (EUR—9762-Vol.2, pp 1049-1060) **Isodose determination in a mixed n, gamma-beam.** Schmidt, R.; Hess, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

For treatment planning with fast neutrons the dose distribution in a phantom must be determined. Megavoltage photon and electron isodose distributions are commonly measured in a water phantom with servo mechanism for 3-dimensional movement. In this paper a commercially available phantom (Wellhofer WP 500) is used in a mixed n, γ-beam. Thimble-type ionization chambers (volume = 0.32 cm^3) are constructed made of A-150, magnesium and graphite wall material and are provided with a gas flow connection. The gas flow and directional dependence of the chambers are checked and the photon response was calibrated in a ^{60}Co-beam. The neutron response of the Mg-Ar and C-CO_2 chamber was determined by modified lead attenuation measurements. For a field size of 10 cm x 10 cm at 80 cm SSD the n, γ-field is scanned by computer control. The grid of the matix was 3.2 mm. Data are unfolded into total dose and photon dose. From depth dose and profile measurements isodose curves are generated using a modified decrement line method. The isodose distributions of the measured and generated matrices are compared. From spectroscopic measurements position dependent corrections of the neutron and photon responses of the applied ionization chambers can be taken into consideration. The influence of these data on the photon distribution will be demonstrated.

23577 (EUR—9762-Vol.2, pp 1073-1086) **Depth dose optimization for neutron capture therapy.** Morstin, K.; Kawecka, B.; Feinendeggen, L.E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Calculations performed to optimize neutron spectra relevant for neutron capture therapy are described. Neutron-induced radiation fields in different models of the human body, partially loaded with ^{10}B or ^{6}Li, are investigated with the Ssub(n) method for varying energy and angular distributions of incident neutrons. Results confirm the superiority of filtered neutron beams. Introduction of D_2O into internal body cavities can significantly improve treatment efficacy. The use of the $^{17}O(n,\alpha)^{14}C$ reaction is suggested.

23578 (EUR—9762-Vol.2, pp 1131-1142) **Intercomparison of the treatment planning systems used for neutron beams in Europe.** Mijnheer, B.J.; Vynckier, S.; Burger, G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A review is presented of characteristics of treatment planning systems currently in use in Europe in all centres which are actively involved in neutron therapy. Details are given of the hardware of the systems, their algorithms and performance under some clinically relevant situations. The information was collected by means of a questionnaire distributed amongst all ECNEU members (European Clinical Neutron Dosimetry Group). The verification of some calculations has been performed by comparing measurements in the local neutron beams with calculations carried out with the local treatment planning system. Relative absorbed dose distributions have been determined in a cubical phantom irradiated with clinically applied neutron beams. Three situations were studied: oblique incidence, wedged fields and tangential beams. The difference between the calculated and measured data were analysed with respect to the physical model applied in the algorithm of the treatment planning system.

23579 (EUR—9762-Vol.2, pp 1143-1154) **Monte-Carlo calculations for a pencil beam model used in treatment planning for d(14) + Be neutrons.** Meissner, P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Treatment planning at the neutron therapy facility in Essen is based on an empirical pencil beam model for d(14) + Be neutrons. This model consists of four components, two for the neutron absorbed dose, two for the photon absorbed dose. The parameters of the beam model are derived empirically from dose distributions - depth dose curves and lateral profiles - measured in water. The applied empirical procedure, however, cannot give sufficient informations about the behaviour of the beam components near the surface of the phantom, since here only depth dose curves measured with an extrapolation chamber but no lateral profiles are available. Therefore there are several possibilities to describe measured dose distributions which differ only within the first centimeters of phantom depth but give the same agreement to measured dose distribution in greater phantom depth. To find out which of the possible descriptions of the neutron beam is the best solution, Monte-Carlo calculations were done. These calculations start with relatively simple models, since at first only qualitative results are required. But it turns out that it is possible to identify the processes described by the components of the empirical beam model, too.

23580 (EUR—9762-Vol.2, pp 1155-1163) **Verification of a commercially available treatment planning, system used for neutron treatment planning.** Horton, J.L.; Roberts, W.K.; Blue, J.W.; Gahbauer, R.A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Neutron treatment plans calculated with the General Electric RT/PLAN treatment planning system have been compared to measurements for a number of simple geometries. These geometries include points on and off-axis for normal and oblique beam incidence. The effects of a circular phantom and the accuracy of calcu-

lations for points near a corner of highly elongated fields are also considered.

23581 (EUR—9762-Vol.2, pp 1165-1176) **Physical treatment planning by several approaches.** Burger, G.; Morhart, A.; Wittmann, A.; Kneschaurek, P. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Neutron isodose planning may be performed by commercial treatment planning systems for photons, providing that certain modifications are applied. All geometry-related corrections such as for nonregular surfaces and oblique incidence remain unchanged. The main modifications concern the tissue-air-ratio, containing essentially the attenuation correction function. We have as a first step applied this modified commercial system to a few regular exposure situations in a homogenious water phantom and compared the generated isodose charts with those derived by direct Monte Carlo calculations of the neutron transport for the corresponding fields. As expected the commercial methods do not incorporate the necessary corrections for the change of scatter conditions in case of oblique incidence or wedged fields. For this reason we developed another approach, based upon the numerical superposition of dose matrices for pencil beams. These matrices were again Monte Carlo calculated. From it build-up functions can be derived by partial radial integration. The isodose charts generated by superposition of pencil beam dose distributions agree much better with directly Monte Carlo calculated ones, than those from the commercial treatment planning system. Based upon these results the method was finally applied to real patients cross sections, as derived from CT or MR-tomography. In the latter case one can even perform a pixelwise attenuation correction, if spin density images are available.

23582 (IA—1421, pp 165-166) **Proton MR study of different types of experimental acute renal failure (ARF) in rats.** Iaina, A.; Abrashkin, S.; Weininger, J. (Barzilai Hospital, Ashkelon, Israel; Israel Atomic Energy Commission, Tel Aviv). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23583 (IA—1421, pp 161-163) **Radiation dosimetry of the Os-191/Ir-191m generator eluate.** Schlesinger, T.; Weininger, J.; Trumper, J.; Issachar, D. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23584 **(IAEA-R—3897-F) Quality control of dosimetry in total body irradiation. Final report for the period 1 September 1985-1 September 1986.** Kallinger, W. (International Atomic Energy Agency, Vienna (Austria)). Nov 1986. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87701512.

An on-line dose measurement system for the quality control of the treatment of leukemia by means of total body irradiation with Co-60 gamma radiation is introduced. An ionization chamber and 5 diodes arranged on the surface of the patient incorporated with a microprocessor provides useful information and data necessary for the treatment. Following the concerted treatment procedure employing this system, the treatment of leukemia by means of total body irradiation is expected to be improved. 9 refs, figs.

23585 **(INIS-mf—10526) Detection of HBsAg and Anti HBc on donors of a blood bank by IRMA and ELISA methods.** Freire Martinez, D.Y. (San Carlos Univ. of Guatemala, Guatemala City. Facultad de Ciencias Quimicas y Farmacia). Oct 1985. 138p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701568.

Comparative evaluation of two methods, Immunoradiometric Assay (IRMA) and Enzyme Immunoassay (ELISA), for detecting HBsAg and Anti HBc was made for determining which is the most advantageous and reliable. The study was made on 300 donors of the Hospital San Juan de Dios Blood Bank. In comparison with the reference method (IRMA), ELISA shows 91.67% of sensitivity. The Anti HBc detection by IRMA is more reliable than the HBsAg detection by IRMA and ELISA for determining the carrier state. 138 refs.

23586 **(INIS-mf—10568) National medical cyclotron facility: report to the Minister of Health by the Medical Cyclotron Committee.** (Medical Cyclotron Committee (Australia)). 31 Oct 1985. 49p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701571.

Research and training in nuclear medicine in Australia are both limited by the lack of a medical cyclotron facility. The Committee recommends the establishment of a national medical cyclotron to provide a supply of short-lived radioisotopes for research in relevant fields of medicine, and for diagnostic use in nuclear medicine.

23587 (INIS-mf—10581, pp 101-104) **AAEC total body nitrogen facility.** Allen, B.J.; Blagojevic, N.; Fallon, J.P.; Linklater, H.; Senior, I.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

A neutron interogation facility has been established at the Lucas Heights Research Laboratories for the in vivo determination of total body nitrogen in malnourished patients. Design parameters of the TBN facility are discussed, with respect to optimisation of nitrogen count rates and reduction of backgrounds. Operational features are described. The facility is used in collaborative studies of cystic fibrosis with the Royal Alexandra Hospital for Children, and of chronic haemodialysis with Royal Prince Alfred Hospital.

23588 **(SIS—1986:3) Digital radiography. I: Basic factor and image processing routines.** Elander, S. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 31p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750691.

The report deals with a project for the development of digital, cerebral angiography competence in Norway. An IIS image processor and a DIGITAL VAX 11/750 were used for the processing of X-ray pictures. The pictures were scanned on an OPTRON C4100 and photographed on a MATRIX INSTR. 3000 videoprinter. The highpass functions Laplace, Roberts, and Sobel were utilized to enhance edges. Further, the room-variant contrast-stretch method WALLIS and the Local Adaptive Histogram Equalization (LAHE) from the SPIDER software package were applied.

23589 **[^{11}C]clorgyline and [^{11}C]-L-deprenyl and their use in measuring functional monoamine oxidase activity in the brain using positron emission tomography.** Fowler, J.S.; MacGregor, R.R.; Wolf, A.P. (to Dept. of Energy). US Patent Application 6-853,119. 17 Apr 1986. 13p. Contract AC02-76CH00016. DE87007235 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007235.

This invention involves a new strategy for imaging the activity of the enzyme monoamine oxidase in the living body by using ^{11}C-labeled enzyme inhibitors which bind irreversibly to an enzyme as a result of catalysis. By using positron emission tomography to image the distribution of radioactivity produced by the body penetrating radiation emitted by carbon-11, a map of functionally active monoamine oxidase activity is obtained. Clorgyline and L-deprenyl are suicide enzyme inhibitors and irreversibly inhibit monoamine oxidase. When these inhibitors are labeled with carbon-11 they provide selective probes for monoamine oxidase localization and reactivity in vivo using positron emission tomography. 2 figs.

23590 Boron uptake in tumors, cerebrum and blood from $[^{10}B]Na_4B_{24}H_{22}S_2$. Slatkin, D.N.; Micca, P.L.; Fairchild, R.G. (to Dept. of Energy). US Patent Application 6-838,494. 11 Mar 1986. 12p. Contract AC02-76CH00016. DE87007218 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007218.

A stable boronated (^{10}B-labeled) compound, sodium mercaptoundecahydrododecaborate is infused in the form of the disulfide dimer, $[^{10}B]Na_4B_{24}H_{22}S_2$, at a dose of about 200 μg ^{10}B per gm body weight. The infusion is preformed into the blood or peritoneal cavity of the patient slowly over a period of many days, perhaps one week or more, at the rate of roughly 1 μg ^{10}B per gm body weight per hour. Use of this particular boronated dimer in the manner or similarly to the manner so described permits radiotherapeutically effective amounts of boron to accumulate in tumors to be treated by boron neutron capture radiation therapy and also permits sufficient retention of boron in tumor after the cessation of the slow infusion, so as to allow the blood concentration of ^{10}B to drop or to be reduced artificially to a radiotherapeutically effective level, less than one-half of the concentration of ^{10}B in the tumor. 1 tab.

23591 Potential for boron neutron capture enhancement of Cf-252 brachytherapy treatment of localized tumors. Schroy, C.B.; Beach, J.L.; Goud, S.N.; Feola, J.M.; Maruyama, Y.; Blue, J.W. (Cleveland Clinic Foundation, Dept. of Radiation Therapy, Cleveland, OH 44106). *Nuclear Science Applications;* **2**: No. 3, 763-769(1986).

Cultured Chinese hamster cells were irradiated with californium-252 neutrons and gamma rays at dose rates of 148 cGy/h and 68 cGy/h, respectively. Survival curves were obtained with and without 60 μg/ml of boron-10 in the culture medium. When the data were fitted to the linear-quadratic model of cell survival it was found that boron increased α (the 'single-hit' parameter) by 32% and decreased β (the "double-hit" parameter) by 8%. The α/β ratio increased to 4.34 Gy in the presence of boron from 3.03 Gy in its absence. This translated to an 8% reduction in californium dose needed to effect 10% cell survival. It is concluded that there may be a sufficiently high thermal neutron fluence present during californium brachytherapy for boron-neutron capture dose augmentation to be feasible. Treatment of inoperable solid local tumors would be of possible benefit.

23592 Historical review of californium-252 discovery and development. Stoddard, D.H. (E.I. Du Pont De Nemours & Co., Savannah River Lab., Aiken, SC 29808). *Nuclear Science Applications;* **2**: No. 3, 189-199(1986). Contract AC09-76SR00001.

The first isotope of californium (/sup 245/Cf) was produced in 1950 at the Radiation Laboratory of the University of California at Berkeley. The Berkeley 60-inch cyclotron was used to bombard curium-242 targets with helium ions having energies of 35 million electron volts. Only a very small amount of the isotope was produced. The isotope californium-252 was first identified along with isotopes of curium and berkelium in the debris from a thermonuclear test explosion in 1952. During the explosion, uranium was subjected to an intense, although short, neutron irradiation so that the uranium atoms absorbed many neutrons before decaying by beta emission to form these isotopes of higher atomic number. Larger quantities of californium-252 can be synthesized by irradiating plutonium-239 or its transmutation products with neutrons in a nuclear reactor. Elements of higher atomic number are built up by successive neutron captures interspersed with beta decays. Thirteen successive neutrons must be added to each nucleus of /sup 239/Pu to convert it to /sup 252/Cf. The first macroscopic amounts of /sup 252/Cf were produced by long-term irradiations in the Materials Testing Reactor at the National Reactor Testing Station in Idaho. Twenty-two milligrams of /sup 252/Cf were produced through March 1969 by irradiations in the High Flux Isotope Reactor at the Oak Ridge National Laboratory. The product was recovered in the associated Transuranium Processing Plant. Additional /sup 252/Cf was made as a byproduct of /sup 244/Cm production at high flux in a Savannah River Plant (SRP) reactor. This /sup 252/Cf and that produced in subsequent high-flux irradiations were used in a market evaluation program.

23593 Tumor and normal tissue effects and therapeutic gain factor for Cf-252. Feola, J.M.; Maruyama, Y.; Beach, J.L. (Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 327-343(1986).

The interaction between radiobiology and radiotherapy is well served by the radiobiologist's contribution to the development and evaluation of experimental models simulating the clinical situation. The initiation of clinical studies at the University of Kentucky in 1976 employing Cf-252 sources provided the opportunity to start a program of radiobiological research, some of whose results are summarized here. The need for more data on the relative biological effectiveness (RBE) of Cf-252 neutron/gamma radiation as a function of dose rate has been recognized. In their initial efforts the authors addressed this problem testing dose rates that were commonly used in the clinic. In particular we used low dose rate (LDR) irradiations. In this paper, the authors review methods and results obtained in the laboratory.

23594 Facility design, environmental protection, and planning method for Cf-252 therapy at the Cancer Institute Hospital, Tokyo. Irifune, T.; Onai, Y.; Tomaru, T.; Uchida, I.; Tsuya, A.; Kaneta, K. (Dept. of Physics, Cancer Institute, Tokyo). *Nuclear Science Applications;* **2**: No. 3, 419-437(1986).

A shielded facility for storage and handling of up to 100 μg of Cf-252 seed assemblies, afterloading cells and tubes, and a remote afterloader using four tubes totaling 60 μg were designed and constructed. The radiation protection survey of the completed facility was performed, and applicability of a guide for spherical shields was confirmed by the present design calculation and survey. For local shielding such as bedside shielding, however, the guide cannot be applied because scattered neutrons from the floor, ceiling, and wall may reach behind the shield. This paper describes the treatment planning method for Cf-252 implants with the aid of a computer.

23595 Facilities and remote afterloading for Cf-252 brachytherapy. Beach, J.L.; Klenn, P.; Mattingly, T. (Dept. of Radiation Medicine, Univ. of Kentucky Medical Center). *Nuclear Science Applications;* **2**: No. 3, 439-450(1986).

The study of Californium-252 brachytherapy has been limited by safety considerations because of the unknown late effects of small doses of neutrons. Because of the potential advantages of treating bulky tumors with neutron implant therapy and the need for large scale cooperative clinical trials to test this therapy. The authors have designed a facility for complete remote storage, sorting and afterloading of Cf-252 sources. The current status of this project and plans for testing the completed device are discussed in this paper. By reducing the neutron exposure to clinical personnel to zero, the hope to remove the question of safety from the question of clinical efficacy of Cf-252.

23596 Lexington studies of Cf-252 brachytherapy for advanced cervical and uterine cancer. Maruyama, Y.; Van Nagell, J.R.; Kryscio, R.; Yoneda, J.; Beach, J.L.; Feola, J.M.; Donaldson, E.; Hanson, M.; Gallion, H. (Radiation Medicine - GYN/Oncology, Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* **2**: No. 3, 467-482(1986).

The most important tumors selected for study in the Lexington clinical trial of /sup 252/Cf have been the advanced stages of cervical cancer, i.e. stage III and IV. These tumors are poorly controlled by conventional photon radiotherapy and local persistence or pelvic recurrence of tumor occurs commonly after radiotherapy in 60-90% of treated patients. During 1975-1979, a group of patients were treated using conventional radiotherapy with delayed /sup 137/Cs implants, experimental radiation using a delayed /sup 252/Cf implant instead of /sup 137/Cs, and early /sup 252/Cf implants before pelvic irradiation. These schedules and the clinical responses of tumors were studied in sequential studies in the authors' clinic. The characteristics of tumor responses are reviewed as well as patient survival. The early implant schedule was developed to treat tumors when they were of maximal size and presumably radioresistance, presumed due to hypoxia. 5-year survival rates were deter-

mined for the different treatments and was 54% for the Cf implants performed early and approximately 15% when delayed /sup 137/Cs or /sup 252/Cf implants were used. These studies indicate that implant schedule was important to outcome for /sup 252/Cf neutron brachytherapy and that the early implant of cervix cancer conferred an advantage for tumor control. Primary and recurrent uterine carcinomas were also studied and were found to be neutron sensitive.

23597 **Treatment of bulky stage IB and IIB cervical cancers with outpatient neutron brachytherapy, external pelvic radiation and extrafascial hysterectomy.** Van Nagell, J.R.; Maruyama, Y.; Yoneda, J.; Donaldson, E.S.; Hanson, M.B.; Gallion, H.H.; Powell, D.E.; Kryscio, R.J. (Div. of Gynecologic Oncology, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* **2**: No. 3, 483-484(1986).

From January, 1977, to December, 1982, twenty-nine patients with bulky (>4 cms diameter) Stage IB or IIB cervical cancer were treated at the University of Kentucky Medical Center by a combination of out-patient neutron brachytherapy (Cf-252) and external pelvic radiation followed by extrafascial hysterectomy. Residual tumor was present in the hysterectomy specimens of 25 per cent. Complications during and following radiation therapy and surgery were minimal and included vaginal stenosis, proctitis, and hemorrhagic cystitis. The mean duration of hospitalization for surgery in these patients was 6.6 days (range 5-15 days) and postoperative morbidity was low. No patient required blood transfusion. Four patients developed urinary tract infections and two had superficial wound separations. Following treatment, patients were seen at monthly intervals for one year, every three months for two years, and every six months thereafter. No patient has been lost to follow-up. Two patients (7 per cent) developed tumor recurrence and have died of disease (1 of distant metastases; 1 local). The remaining 27 patients (93 per cent) are alive and well with no evidence of disease 24-89 months (mean 48 months) after therapy. No radiogenic fistulae or bowel obstruction were observed. These preliminary results suggest that the combination of outpatient neutron brachytherapy, external pelvic radiation, and extrafascial hysterectomy for patients with Stage IB and IIB cervical cancer is well tolerated. Complications associated with this treatment regimen have been minimal, and the recurrence rate is low. The duration of intracavitary neutron brachytherapy was short, and outpatient therapy was well received by patients.

23598 **Cf-252 brain implantation for malignant glioma: Experience of the University of Kentucky, Lexington.** Chin, H.W.; Maruyama, Y.; Yong, A.B.; Beach, J.L.; Tibbs, P.A.; Markesbery, W. (Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 585-598(1986).

Since 1980, —65 patients with hemispheric malignant gliomas have been treated in studies testing Cf-252 neutron brain implant therapy combined with whole/part brain radiotherapy to —6000 cGy. Methods, techniques, number of tubes implanted and the placement of tubes relative to the contrast enhanced edge of the tumor and brain imaging have evolved during this time. The patients receiving single tube implant had marked improvement in their performance status but a survival period of only —1 year. With the use of multiple tubes, survival results improved and was 63% at 12 months and continues at —30% at about 2 years. The advent of tumor staging using CT and MR scanning, multiple tube stereotaxic implants placed around the enhancing edge of the lesion and whole/part brain radiation may further improve local tumor control. Methods for the conduct of a therapeutic trial that could lead to more effective treatment of malignant tumors appear to be evolving.

23599 **Hyperthermia and Cf-252 neutron brachytherapy for bulky surface human neoplasms.** Maruyama, Y.; Wills, C.; Beach, J.L.; Nelson, O.; Luce, E. (Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 713-718(1986).

Hyperthermia was used with Cf-NT to treat bulky surface neoplasms and appeared to aid the clearance and local control of selected neoplasms. Hyperthermia given in close temporal sequence with Cf-252 plaque therapy aided the clearance and local control of a radiation-induced osteogenic sarcoma. Hyperthermia given in conjunction with fractionated photon radiation after plaque Cf-252 therapy also appeared to aid the local control of a massive poorly differentiated carcinoma. Both remained under local control after combined modality therapy.

23600 **Metronidazole in the treatment of cervical cancer using Cf-252 neutron brachytherapy.** Maruyama, Y. (Dept. of Radiation Medicine, Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* **2**: No. 3, 719-726(1986).

Metronidazole was tested for its possible use in the Cf-252 brachytherapy of cervical cancer as a radiosensitizer and to deal with anaerobic pelvic infection. 15 patients were treated by only 14 were evaluable. All stages from stage IB-IVB were treated and complete local tumor regression was noted in all cases although it could take place very slowly. 5/14 (36%) are 1.5-3 year survivors but only among the patients with stage I-II disease. No unusual radio-enhancing action was observed but metronidazole appeared to be useful to treat the vaginal, cervix and uterine infections often associated with high stage disease and bulky, ulcerative or necrotic tumors.

23601 **Experience with and potential of Cf-252 therapy for other tumors: Lexington clinical trials.** Maruyama, Y. (Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 601-614(1986).

Clinical observations of tumor response in a variety of sites to Cf-252 (Cf) neutron brachytherapy (NT) are described. Many tumors which are accessible and easily implanted are suitable for Cf-NT, but in advanced stages, must be integrated into a more comprehensive program of local, regional and systemic therapy. With local tumor clearance and control, there should be treatment for regional disease using conventional photon radiotherapy; adjuvant therapies for disseminated disease using systemic therapy is also needed. While potential for therapy exists for Cf-NT treatment of many tumors, additional clinical trials carried out in a variety of global settings are needed where different tumors are common and are available for studies. Tumors suitable for study include e.g. cervix, uterus, vagina, tonsil-oropharynx, anterior oral cavity, prostate, female urethra, nasopharynx, anus and rectum, malignant glioma, parotid, perhaps esophagus, bladder, non-oat cell lung, localized sarcoma and melanoma, etc.

23602 **OER by survival time for Cf-252, low dose rate Cs-137 and acute Co-60 for LSA lymphoma.** Maruyama, Y.; Feola, J.M.; Magura, C.; Onomura, C.I.; Beach, J.L. (Radiation Medicine, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 757-761(1986).

RBE and OER were determined for LSA tumor by survival time assay. The RBE/sub n/ of Cf vs. Cs-137 was 5.8 and the OER was —1.4 by experiments performed in vitro and assayed in vivo. When tumor was irradiated in an advanced state in the living mouse, the RBE/sub n/ was determined to be 5.2 vs. Cs-137. The RBE for hypoxic tumor is larger than for the oxic tumor for Cf-252 neutron irradiation.

23603 **Effect of Cf-252 neutron implantation on dog brain.** Chin, H.W.; Markesbery, W.; Young, A.B.; Maruyama, Y. (Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* **2**: No. 3, 803-807(1986).

Cf-252 implants were carried out into normal dog brain in an experimental study. Animals were followed for one year with neurological, performance status evaluation, serial CT and MRI scans and autopsy study of animals sacrificed early or at one year. Changes produced by 1000 cGy equivalents of Cf-252 were minimal and resembled those produced by 1000 cGy of acute Co-60 irradiation.

23604 Boron enhancement of high LET Cf-252 brachytherapy in the brain. Beach, J.L.; Ashtari, M.; Harris, M.R. (Dept. of Radiation Medicine, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* 2: No. 3, 821-825(1986).

The authors have investigated the potential enhancement in dose distribution and cell killing effectiveness for Cf-252 brain implants by the addition of boron-10 enriched boron compounds which cross the blood brain barrier. There is a significant enhancement in both the absorbed dose and the high LET event frequency at distances of 3-5 cm from the sources. The principal difficulty, aside from toxicity and delivery problems, is a tendency for the thermal neutron distribution to peak at the center of the head instead of centering on the source distribution. The increase in cell killing was found to closely parallel the increase in absorbed dose from the boron capture events.

23605 Neutron brachytherapy for malignant glioma at the University of Kentucky, Lexington. Young, A.B.; Chin, H.W.; Beach, J.L.; Maruyama, Y. (Dept. of Neurosurgery Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* 2: No. 3, 577-584(1986).

Patients harboring a glioblastoma multiforme have a grim prognosis. The median survival of these patients is only 10 to 12 months. A review of the most frequently cited series of patients with glioblastomas, the median survival was 6 months. Only 7.2% of patients lived for two years. The median survival for patients treated with surgery alone was 4 months, surgery and irradiation 9.5 months, and surgery, irradiation, and chemotherapy 10 months. According to the report of the Brain Tumor Study Group, the best arm (surgery, irradiation, and BCNU) obtained a median survival of only 51 weeks. Although the reports of the group are frequently quoted and used as a basis for giving chemotherapy, the actual conclusion of the study is that chemotherapy made no significant difference in survival of patients when compared with radiation therapy and surgery. Their major finding was that the only significant contributor to increased survival was irradiation. Likewise, intraarterial delivery of chemotherapeutic agents and immunotherapy trials have not shown significant prolongation of median survival. Although these results have led to a sense of hopelessness among neurosurgeons about the treatment of glioblastoma multiforme, several developments have brightened the prospects for treating these lesions. The authors discuss these developments in further detail.

23606 Microdosimetric studies of Cf-252. Beach, J.L.; Harris, M.R. (Dept. of Radiation Medicine, Univ. of Kentucky Medical Center, Lexington, KY 40536). *Nuclear Science Applications;* 2: No. 3, 283-290(1986).

The authors have analyzed the microdosimetric distribution of specific energy f(y) around a Cf-252 implant in order to determine the probability of producing a microdosimetric high LET miss in clonogenic cell nuclei. The high LET miss probability depends on the choice of critical specific energy (yc) as well as the absorbed dose in the tissues in question. It is found that in most bulky tumors there is a high probability that cell nuclei near the periphery will contain no events of specific energy above 20 keV/μ. The authors have postulated that the lower LET components of Cf-252 and external beam photon dose are important elements in local control of solid tumors implanted with Cf-252. Certain implications for scheduling these components are discussed.

23607 Optimization of epithermal neutron beams for neutron capture therapy. Fairchild, R.G. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* 53: 25-26(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Neutron capture therapy (NCT) has intrigued investigators since shortly after the discovery of the neutron. Since products from the $^{10}B(n,\alpha)^{7}Li$ reaction have ranges limited to approximately one cell diameter, conditions ideal for radiotherapy are possible, assuming that cancer cells can be selectively targeted with therapeutic amounts of boron. In addition, the highly ionizing particles have advantages commonly accorded to high linear energy transfer radiation (i.e., little repair, greater effectiveness against hypoxic cells, and a relatively constant radiosensitivity throughout the cell cycle). Considerable effort has recently been directed toward the synthesis of boron compounds showing selective affinity for tumors; this work has led to the development of some biomolecules showing a ^{10}B ratio approaching 10 and extended biological half-lives (sulfhydryl boron hydrides, amino acids, porphyrins, antibodies). Dosimetric aspects of thermal and epithermal beams have been reviewed in the context of the various parameters involved, i.e., boron concentration and tumor/normal tissue concentration ratio (^{10}B ratio), tumor depth, thermal neutron flux density, and biological effects of the various mixed field components. Results are summarized in terms of the minimum ^{10}B concentration required for effective therapy. The deeper penetration of the higher average energy neutron beams provide clear advantages for NCT.

23608 Boronated monoclonal antibody conjugates for neutron capture therapy. Borg, D.C.; Elmore, J.J. Jr.; Ferrone, S. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* 53: 30-31(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Monoclonal antibodies (MoAbs) to tumor-associated antigens are attractive for concentrating ^{10}B in cancer tissue, in part because neutron capture therapy (NCT) is not disadvantaged by the hours to days required to optimize tumor:background concentration ratios of MoAbs or their $F(ab')_2$ or Fab fragments. Since direct coupling of ^{10}B compounds in amounts sufficient for radiotherapy appears to inactivate MoAbs, the authors used dextran intermediate carriers to provide high levels of ^{10}B per MoAb while modifying fewer amino acid residues.

23609 Acute CNS syndrome from $^{10}B(n,\alpha)^{7}Li$ irradiation of mouse brain. Slatkin, D.N.; Stoner, R.D.; Rosander, K.M.; Kalef-Ezra, J.K.; Laissue, J.A. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* 53: 34-35(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The purpose of this study is to compare absorbed doses of ^{10}B-neutron capture radiation and x radiation in the brains of head-exposed, body-shielded mice, at LD_{50} for acute (<4 days post exposure) mortality from the central nervous system (CNS) radiation syndrome. This comparison leads to an estimate of the in vivo relative biological effectiveness (RBE) of heavy particle radiation (helium and lithium ions) from the $^{10}B(n,\alpha)^{7}Li$ nuclear reaction.

23610 Choosing measures of central tendency in biological research applications. Fields, D.E. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* 53: 36-37(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

When presenting experimental results, or when choosing the value of a variable to be used in a simulation, it is often required that a representative value be given. This value may be a mean, an average, a median, a log-mean, an expectation value, or some other measure of central tendency. Deciding which of these variable types is appropriate to use in a given application and determining the actual value require consideration of the statistical distribution of the data. Typical statistical distributions found in biological systems are (a) normally distributed values (the frequencies of occurrence of the values define the familiar bell-shaped curve) and (b) lognormally distributed values (the frequencies of occurrences of the logarithms of the values define the bell-shaped curve). The authors have developed and applied a computer code that may be used to test assumptions about the type of statistical distribution (either normal or lognormal) of a set of measured values and to determine measures of central tendency based on the actual data. These representative values are calculated in a manner appropriate to the distribution.

23611 **Patterns of brain activity in normals and schizophrenics with positron emission tomography.** Volkow, N.D.; Wolf, A.P.; Gomez-Mont, F.; Brodie, J.D.; Canero, R.; Van Gelder, P.; Russell, J.A.G. (Brookhaven National Labs., Upton, NY). *Journal of Nuclear Medicine;* **26**: No. 5, 106(May 1985). (CONF-850611—).

From 32. annual meeting of the Society of Nuclear Medicine; Houston, TX, USA (2 Jun 1985).

The authors investigated the functional interaction among brain areas under baseline and upon activation by a visual task to compare the response of normal subjects from the ones of chronic schizophrenics. Cerebral metabolic images were obtained on twelve healthy volunteers an eighteen schizophrenics with positron emission tomography and 11-C-Deoxyglucose. Correlation coefficients among the relative metabolic values (region of interest divided by the average of whole brain gray matter) of 11 brain regions; frontal, parietal, temporal and occipital left and right lobes, left and right basal ganglia and thalamus were computed for the baseline and for the task. Under baseline, normals showed more functional correlations than schizophrenics. Both groups showed a thalamo-occipital (positive) and thalamo-frontal (negative) interaction. The highest correlations among homologous brain areas were the frontal, occipital and basal ganglia.

23612 **Microdosimetric spectra of heavy ion beams.** Metting, N.F.; Braby, L.A.; Rossi, H.H.; Kliauga, P.J.; Howard, J. (Pacific Northwest Lab., Richland, WA 99352). pp 45 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—). Contract AC06-76RL01830;AC02-83ER60142.

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

The microscopic spatial distribution of energy deposition in irradiated tissue plays a significant role in the final biological effect produced. Therefore, it is important to have accurate microdosimetric spectra of radiations used for radiobiology and radiotherapy. Recent experiments performed at LBL's Bevalac Biomedical facility were designed to accurately measure the radial distribution of energy deposition around high energy heavy ion tracks. A small (6.4 mm diameter) proportional counter mounted in a large (600 x 2500 mm) vacuum chamber was used. Charged particle equilibrium is essential in order to make this measurement. Since the accelerator beam diameter cannot be made large enough to provide charged particle equilibrium, energy deposition was measured as a function of the distance between detector and primary ion track. The microdosimetric distributions for a uniform field were then calculated. This paper discusses the rationale of the experimental design as well as the analysis of the first measurements of neon, argon, and iron ion beams.

5507 Microbiology

REFER ALSO TO CITATION(S) 22111, 22112, 22133, 22354, 22360, 22363, 22372, 22373, 22374, 22375, 22376, 22377, 22378, 23536

23613 (CONF-8511136—, pp IV.89-IV.98) **Microbial processing of fuels.** Wilson, B.W.; Lewis, E.; Stewart, D.L.; Li, S.M.; Bean, R.M.; Chess, E.K.; Pyne, J.; Cohen, M.; Aranson, H. (Battelle Pacific Northwest Labs., Richland, WA; Univ. of Hartford, West Hartford, CT). 1985. NTIS, PC A99/MF A01. File Number DE87006353.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

Possible degradation or liquefaction of low rank coals and lignite by microbial digestion is of interest because of its potential for conversion of these lower quality fuels. We have investigated several uses for microbes in the beneficiation of coal and coal products, including direct conversion of subbituminous coal and lignite, enhancement of coal/water slurries, and upgrading of coal derived liquids by the removal of nitrogen. In the course of these studies we have isolated the laccase enzyme thought to be primarily responsible for lignite degradation, and tested its ability to solubilize low rank coal. We have recently carried out characterization of a liquid product obtained by the University of Hartford from lignite using the fungus Polyporous versicolor. This paper presents an overview of progress in the last year in all of these areas as well as specific results from chemical analyses of the University of Hartford materials. 5 refs., 4 tabs.

23614 (INIS-mf—10578, pp P31) **Synthetic biotinylated and /sup 32/P-labelled 26mer oligonucleotide probe for the detection of campylabacter jejuni.** Van Schalkwyk, T.V.; Greeff, A.S.; Crewe-Brown, H.H. (Medical Univ. of Southern Africa, Pretoria, South Africa. Dept. of Collective First Year training; Medical Univ. of Southern Africa, Pretoria, South Africa. Dept. of Microbiology). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23615 (INIS-mf—10578, pp P347) **Molecular biological investigation of an aphid picornavirus.** Williamson, C.; Von Wechmar, M.B.; Rybicki, E.P. (Cape Town Univ., South Africa. Dept. of Microbiology). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23616 (INIS-mf—10578, pp P289) **Self vs. non-self distinction in digestive vacuoles of the Amoeba dictyostelium discoideum.** Du Plessis, R.; Haylett, T.; Thilo, L. 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

5509 Pathology

REFER ALSO TO CITATION(S) 23551, 23691

23617 (CONF-8608165—1) **A system for the analysis of cohort mortality data.** McLain, R.; Frome, E.L. (Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400;AC05-76OR00033. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006370.

From SAS users group international conference: SUGI II; Cary, NC, USA (18 Aug 1986).

A system is developed for the analysis of cohort mortality data. This Mortality Analysis System (MAS) is designed as a research tool in epidemiologic studies. The system allows a researcher to investigate the effect of one or more factors on the mortality of a study cohort. Variables can be categorized as factors to allow for stratification in the analysis. DATA steps and PROC MATRIX are incorporated in the system to produce the output. Person-years, observed deaths, and expected deaths are calculated and cross-classified by the levels of the factors. The resulting data set can be used to compute the standardized mortality ratios (SMR) for each stratum level. Poisson regression models can then be used for further statistical analysis. 11 refs., 3 tabs.

23618 (UCRL—96017) **Image cytometry of duct cells from benign and malignant breast disease.** Mayall, B.H.; Gadenne, C.; King, E.B.; Chew, K.L.; Duarte, L.A.; Petrakis, N.L. (California Univ., San Francisco (USA); Lawrence Livermore National Lab., CA (USA); Centre de Lutte Contre le Cancer Gustave-Roussy, 94 - Villejuif (France)). 22 Jan 1987. Contract W-7405-ENG-48. 7p. (CONF-8604306—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006688.

From Elmau international symposium; Elmau, F.R. Germany (20 Apr 1986).

We used image cytometry to classify benign and malignant breast lesions, to identify parameters that classify premalignant le-

sions, and to assess these parameters for a biological association that may be linked with malignancy. Results suggest that quantitative image analysis is able to discriminate "normal" from "abnormal" breast lesions. Thus image cytometry may provide an objective approach for early detection of malignant changes in the breast. The parameters selected by stepwise discriminant and regression analyses as being most useful for discriminating among breast lesions relate to nuclear size, shape and DNA content. These parameters are robust and easily measured and are similar to those used by others for discriminating benign from malignant lesions. Significantly, no parameter based on nuclear chromatin distribution ranked as highly in this study, unlike our experience with studies of other premalignant lesions. 9 refs., 1 fig., 3 tabs.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 23540

5520 Public Health

REFER ALSO TO CITATION(S) 22666, 22808, 23434, 23436

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 22365, 22981, 23428, 23641

23619 (IA—1421, pp 150-151) **Radioimmunoassay of chloramphenicol using chloramphenicol-succinyl-amido-tyramine-[/sup 3/H] as radiotracer.** Buchman, O.; Canfi, A.; Shimoni, M.; Zafran, M.; Hagag, Y.; Cohen, A.; Teitelbaum, Z. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23620 **(IAEA-TECDOC—392) In vitro technology for mutation breeding. Reports of the first and second research co-ordination meetings held in Vienna, 31 October-4 November 1983 and 22-28 August 1985.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). Oct 1986. 58p. (CONF-850805—Summ.; CONF-8310441—Summ.). NTIS (US Sales Only), PC A04/MF A01. File Number DE87701617.

From International symposium on nuclear techniques and in-vitro culture for plant improvement; Vienna, Austria (19 Aug 1985).

The ultimate aim of the Co-ordinated Research Programme on In Vitro Technology for Mutation Breeding is to provide new effective tools for plant breeders to construct new cultivars, thus increasing agricultural production of food, feed and industrial raw material, particularly in developing countries. The participants of the research co-ordination meetings considered the potential of new advances of agricultural biotechnology, especially the use of in vitro techniques for mutation breeding. They discussed and co-ordinated plans in conjunction with the impact on plant breeding of novel technologies, such as use of somaclonal variation, cell hybridization and molecular genetics. Refs.

23621 **(IC—86/146) Bioeconomic study of a multispecies pest subjected to a pesticide.** (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701459.

The paper deals with a community of two ecologically independent insect species subjected to a combined spray of insecticides. The growth equations for the community are constructed taking breeding into account and assuming the presence of some sexually sterile males in the populations. The dynamical behaviour of the community is explained at length. A bioeconomic analysis of the spraying programme is undertaken and the existence of a bionomic equilibrium is proved. The optimal spraying policy is studied with the help of Pontryagin's maximum principle. Lastly, the principal results are summarized. 8 refs, 4 figs.

23622 (INIS-mf—10578, pp P208) **Microbiology and radurization of dehydrated food products.** Niemand, J.G.; Van der Watt, H.H. (Iso-Ster, Kempton Park, South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23623 (INIS-mf—10578, pp P206) **Systematics and characteristics of radiation resistant Lactobacilli from radurised meat.** Hastings, J.W.; Holzapfel, W.H. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria. Dept. of Isotopes and Radiation; Pretoria Univ., South Africa. Dept. of Microbiology). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23624 (INIS-mf—10578, pp P178) **Biochemical changes in stress response of γ-irradiated ripening mango fruit.** Frylinck, L.; Dubery, I.A.; Schabort, J.C. (Rand Afrikaans Univ., Johannesburg, South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23625 **(RISO-M—2591) Symbiotic nitrogen fixation and nitrate uptake by the pea crop.** Jensen, E.S. (Risoe National Lab., Roskilde (Denmark)). Aug 1986. 104p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750889.

Symbiotic nitrogen fixation and nitrate uptake by pea plants (Pisum sativum L.) were studied in field and pot experiments using the /sup 15/N isotope dilution technique and spring barley as a non-fixing reference crop. Barley, although not ideal, seemed to be a suitable reference for pea in the /sup 15/N-technique. Maximum N/sub 2/ fixation activity of 10 kg N fixed per ha per day was reached around the flat pod growth stage, and the activity decreased rapidly during pod-filling. The pea crop fixed between 100 and 250 kg N ha/sup -1/, corresponding to from 45 to 80 per cent of total crop N. The amount of symbiotically fixed N/sub 2/ depended on the climatic conditions in the experimental year, the level of soil mineral N and the pea cultivar. Field-grown pea took up 60 to 70 per cent of the N-fertilizer supplied. The supply of 50 kg NO/sub 3/-N ha/sup -1/ inhibited the N/sub 2/ fixation approximately 15 per cent. Small amounts of fertilizer N, supplied at sowing (starter-N), slightly stimulated the vegetative growth of pea, but the yields of seed dry matter and protein were not significantly influenced. In the present field experiments the environmental conditions, especially the distribution of rainfall during the growth season, seemed to be more important in determining the protein and dry matter yield of the dry pea crop, than the ability of pea to fix nitrogen symbiotically. However, fertilizer N supplied to pot-grown pea plants at the flat pod growth stage or as split applications significantly increased the yield of seed dry matter and protein.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 23561, 23684, 23692

23626 **(AD-A—175840/8/XAB) Severity levels and symptoms complexes for acute radiation sickness -- description and quantification. Technical report, 6 January 1984-31 March 1985.** Anno, G.H.; Wilson, D.B.; Baum, S.J. (Pacific-Sierra Research Corp., Los Angeles, CA (USA)). 30 Nov 1985. 80p. (PSR—1597). NTIS, PC A05/MF A01.

This report develops a descriptive/quantifying structure to express and gage the severity of symptoms, from symptom complexes, and construct a dose/time map of the symptom sequelae following prompt ionizing-radiation exposure and injury in humans. Radiation doses in the range of 75 to 4500 rads and postexposure time up to 6 weeks are considered. Symptom-severity levels, ranging from level 1 (no apparent effect) to level 5 (maximum severity), are defined for each of 6 symptoms categories including: (1) upper gastro-intestinal distress, (2) lower GI distress, (3) fatigability and weakness, (4) hypotension, (5) infection, bleeding, and fever, and (6) fluid loss and electrolyte imbalance. Temporal profiles of symptom severity are developed for the 6 symptom categories as well as for the symptom complexes formed by combining each symptom category according to severity level along postexposure time. About 100 different symptom complexes cover the dose and time ranges of interest. A dose/time mapping of the symptom complexes was used to select 30 to 40 of the most important ones. Those were included on U.S. Army questionnaires designed to obtain personnel judgments of task performance under various degress of debilitation. The incidence of upper GI distress, lower GI distress, fatigability and weakness, and early diarrhea are estimated based on probit and logit analyses of medical data.

23627 **(DOE/EH—0036) Radiation exposures for DOE and DOE contractor employees Eighteenth annual report, 1985.** (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. 60p. NTIS, PC A04. File Number DE87006767.

All US Department of Energy (DOE) and DOE contractors are required to submit occupational radiation exposure records to a central repository. The data required include a summary of whole-body exposures to ionizing radiation, a summary of internal depositions of radioactive materials above specified limits, and occupational exposure reports for terminating employees. This report is a summary of the data submitted by DOE and DOE contractors for 1985. A total of 95,806 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposures in 1985. In addition to the employees, 96,665 visitors were monitored. Of all employees monitored, 58.4% received a dose equivalent that was less than measurable, 39.8% a measurable exposure less than 1 rem, and 1.9% an exposure greater than 1 rem. One employee received a dose equivalent greater than 5 rem (8.66 rem). The exposure received by 91.9% of the visitors to DOE facilities was less than measurable. No visitors received a dose equivalent greater than 2 rem. The collective dose equivalent for DOE and DOE contractor employees was 8223 person-rem. The collective dose equivalent for visitors was 461 person-rem. These averages are significantly less than the DOE 5-rem/year radiation protection standard for whole-body exposures. Ten new cases of internal depositions were reported in 1985 that exceeded 50% of the pertinent annual dose-equivalent standard. Of these ten cases, eight occurred in a previous year and are reported now because recent revisions in the dose calculations established these cases as reportable depositions. Twenty-six cases reported during 1985 were considered to be the continued tracking of previous depositions. 5 figs., 32 tabs.

23628 **(DOE/ER/60317—T1) [Development of recommendation for protection against radiation emitted by internally deposited radionuclides]: Technical progress report, 1 March 1986 to 28 February 1987.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 6 Mar 1987. Contract FG01-85ER60317. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87006229.

This is the semiannual technical progress report for the National Council on Radiation Protection and Measurements. This submission is the final technical report for the grant year 1 March 1986 to 28 February 1987. Council review of the draft of Scientific Committee 1 was completed during 1986 and modification on the basis of the Council members' comments was underway at the close of the year. The Report includes new recommendations for both occupational and public exposure. Important modifications of the NCRP's earlier recommendations on basic radiation protection criteria include discontinuance of the age proration formula for workers' exposures, new accumulation controls for exposure of the fetus under occupational conditions and the adoption of a negligible individual risk level. Also important is the assignment of new values to the quality factor for some radiations of high linear energy transfer. It is expected that the work on the report can be completed so that publication will be possible early in 1987.

23629 **(DOE/ID—12105) Quality assurance manual for the Department of Energy laboratory accreditation program for personnel dosimetry systems.** (USDOE Radiological and Environmental Sciences Lab., Idaho Falls, ID). Feb 1987. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006374.

The overall purpose of this document is to establish a uniform approach to quality assurance. This will ensure that uniform, high-quality personnel dosimetry practices are followed by the participating testing laboratories. The document presents guidelines for calibrating and maintaining measurement and test equipment (M & TE), calibrating radiation fields, and subsequently irradiating and handling personnel dosimeters in laboratories involved in the DOE dosimetry systems testing program. Radiation energies for which the test procedures apply are photons with approximately 15 keV to 2 MeV, beta particles above 0.3 MeV, neutrons with approximately 1 keV to 2 MeV. 12 refs., 4 tabs.

23630 (EUR—9762-Vol.1, pp 3-33) **Experimental studies on neutron carcinogenesis: their possible relevance for radiation protection.** Broerse, J.J.; Hennen, L.A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

With respect to radiation protection the following aspects of experimental studies on neutron carcinogenesis are of relevance: Assessment of the nature of dose-response relationsips; Determination of the relative biological effectiveness of radiations of different quality; Effects of fractionation or protraction of the dose on tumour development. A number of studies on in vitro carcinogenesis and on tumour induction in animals after irradiation with neutrons and X-rays are summarized. For the analysis of tumour data in animals, specific approaches, such as nonparametric actuarial methods are proportional hazard functions have to be applied. The dose response curves for radiation induced cancers in different tissues vary in shape. This is exemplified by studies on myeloid leukemia in mice and mammary tumours in different rat strains. The results on radiation carcinogenesis in animal models clearly indicate that the highest RBE values are observed for neutrons with energies between 0.5 and 1 MeV. On the basis of such results it might be concluded that the maximum quality factor of 10 for neutrons should be increased. Based on current evidence, an increase by a factor of 2 to 3 seems more realistic than a tenfold rise. The experimental studies performed up to the present do not allow to quote organ specific quality factors. The diversity of dose-response relationships point to different mechanisms involved in the induction of different tumours in various species and even in different strains of the same species.

23631 (EUR—9762-Vol.1, pp 35-43) **Analysis of mortality from different causes of death in mice exposed to fast neutrons.** Coppola, M.; Covelli, V.; Di Majo, V. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umwelforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The results of a further analysis of data obtained from a large experiment carried out at the Laboratory of Pathology of CRE Casaccia on mice irradiated with neutrons and with X-rays at different ages are reported. In particular, the attention is focused on the possible relationship of the life-span shortening observed in irradiated animals with the different causes of death. In the case of young adult mice, data have been separately analysed for tumour free and tumour bearing mice, and showed that a marked life-span shortening is associated with incidence and rate of radiation induced neoplasms. In addition the occurrence of solid tumours, evaluated as age adjusted final incidences, indicated a sharp increase already at very low doses of neutrons while for X-rays this phenomenon was essentially confined in the range of 3 to 6 Gy. From these data the possibility of evaluating neutron RBE at low doses, as well as the implications for quality factors, are discussed.

23632 (EUR—9762-Vol.1, pp 45-55) **Shape of the RBE-dose relationship for fast neutrons at low doses for somatic mutations in Tradescantia.** Pihet, P.; Menzel, H.G.; Garot, G.; Wambersie, A. 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The shape of the RBE-dose relationship for fast neutrons was investigated for somatic mutations in Tradescantia stamen hairs. This system is particularly suitable for RBE determination at low dose (below 0. 1 Gy). Neutron irradiation were performed with p(65)+Be neutron beams produced at the cyclotron CYCLONE of Louvain-la-Neuve. Co-60 gamma rays were used as reference radiation. Single doses were delivered, the dose rate being adjusted to obtain irradiation times ranging from 2 to 4 min. Inflorescences of Tradescantia clone 02 were used. Pink and colourless mutations were scored. For pink mutant events, RBE for p(65)+Be neutrons increases from 5.7 to 10.8 for neutron doses decreasing from 0.10 to 0.005 Gy. The neutron dose-effect relationship was fitted by a linear relation, while for gamma-rays, a linear-quadratic relation was used. From the ratio of the linear components, a maximum RBE value of 11.9 could be derived. Present data are compared with other available RBE data obtained for the same system for low energy monoenergetic neutrons. The RBE data have been correlated with the microdosimetric characteristics of the neutron beams.

23633 (EUR—9762-Vol.1, pp 57-68) **Current biophysical approaches to the understanding of biological effects of radiation in terms of local energy deposition.** Goodhead, D.T.; Charlton, D.E.; Wilson, W.E.; Paretzke, H.G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Relevant biological effects of radiation in mammals are due mostly to radiation damage to individuals cells. It is also well estabilshed that the spatial and temporal distribution of radiation interactions within the cell or its nucleus (diameter approximately 10 microns) has an important influence on biological effectiveness. Therefore these distributions must be considered if we are seeking either practical quantities for comparison of different radiations in radiation protection or therapy, or if we are seeking a more fundamental understanding of the mechanisms of action. Local energy deposition can readily be measured experimentally over the larger subcellular dimensions (down to 1 micron). Monte-Carlo track structure techniques allow calculation of local energy deposition, and many other properties, down to 1 nm. The structure of Monte-Carlo simulated tracks of alpha-particles and protons (such as are produced by neutron irradiation) are discussed in relation to the dimensions of possible subcellular genetic targets. The biologically relevant properties of the radiations must be sought amongst a vast back-ground of biologically 'irrelevant' atomic damage. This search may be guided by radiobiological experimental data for diverses radiations and by biophysical models of radiation action. These highlight the apparent importance of properties of radiation tracks over very small distances of less than 100 nm. Consequently computations are being undertaken of distributions of local energy deposition in small geometric volumes (includng simple models of DNA and chromatin) of dimensions down to 1 nm, for a wide variety of radiations. It is shown that with appropriate assumptions it is possible to predict the absolute probabilities of cell death (per unit absorbed dose) for a variety of alpha-particles energies.

23634 (GSF-BPT—4/86) **Ultraviolet-B-effects on plants: Spectra of harmful effects, primary damage and UV protective mechanisms. Final report.** Wellmann, E.; Beggs, C.; Moehle, B.; Schneider-Ziebert, U.; Steinmetz, V.; Koch, U. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). 1986. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751335.

In two model systems of higher plants, damage caused by ultraviolet-B-radiation was analysed as to its mechanism of action and the spectral quantum efficiency. These investigations were to provide information on the relevance of such UV effects in cases of increased ultraviolet-B-irradiation owing to the destruction of ozone. The results indicate the very high tolerance of the plants to ultraviolet-B-radiation which obviously is the result of very effective protective mechanisms, and show at the same time that potential damage must already be reckoned with, given the current share of ultraviolet-B-radiation in solar radiation. Should ultraviolet-B-radiation be increased, then indirect damage to the plant from the destruction of ultraviolet protective mechanisms through UV-B-radiation will probably constitute a particular risk.

23635 (IA—1421, pp 148-149) **Fertility following neonatal gamma irradiation.** Freud, A.; Sod-Moriah, U.A. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23636 (IA—1421, pp 149) **Altered ovarian responsiveness to gonadotropins in neonatally irradiated immature female rats.** Freud, A.; Sod-Moriah, U.A. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23637 (IA—1421, pp 149-150) **Effects of neonatal low dose gamma irradiation or high ambient temperature on the ovarian binding of radioiodinated HCG.** Freud, A.; Canfi, A.; Shaked, I.; Sod-Moriah, U.A.; Chayoth, R. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23638 (IA—1421, pp 163-164) **Os-191 biodistribution studies in mice.** Weininger, J.; Trumper, J.; Issachar, D. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23639 (INIS-BR—583) **Legal aspects related to workers and ionizing radiation.** Faria, N.M. de; Fischer, D. (Associacao Brasileira de Ensaios Nao Destrutivos, Sao Paulo). 1985. 14p. (In Portuguese). (CONF-8505346—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701622.

From Seminar on worker in nuclear activities; Rio de Janeiro, Brazil (1 May 1985).

The legal aspects related to protection of the worker during its activity and in case of accident which involves dead or invalidity or occupation disease are presented. The aspects concerning to employment relation for workers in nuclear installations, and the

professional liability for workers who handle ionizing radiation are discussed. (M.C.K.).

23640 **(INIS-mf—10576) Sixth Czechoslovak biophysical congress with international participation. Abstracts of papers.** (Ceskoslovenska Lekarska Spolecnost J.E. Purkyne, Prague; Karlova Univ., Plzen (Czechoslovakia). Lekarska Fakulta). 1985. 4p. (CONF-8504292—Exc.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701460.

From 6. Czechoslovak biophysical congress with international participation; Bratislava, Czechoslovakia (10 Apr 1985).

The conference proceedings contains 67 papers of which 4 papers were included in INIS. The subject of these was the application of tracer techniques to studying cell membrane permeability to strontium, the labelling of phospholipids with /sup 32/P, and biological radiation effects on DNA and lipids. (J.P.).

23641 (INIS-mf—10578, pp P249) **Effect of γ radiation on the NADP sup (+) dependant malate dehydrogenase (decarboxylating) from Mangifera indica L. .** Viljoen, B.; Dubery, I.A.; Schabort, J.C. (Rand Afrikaans Univ., Johannesburg, South Africa). 1986. NTIS (US Sales Only), PC A22/MF A01. File Number DE87780106. (CONF-8606256—).

From 1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology; Johannesburg, South Africa (29 Jun 1986).

23642 (INIS-mf—10580-Vol.2, pp 170-175) **Determination of radionuclides in wounds.** Shlyuter, V. 1983. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780113. (CONF-8205317—Vol.2).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The measuring equipment for the radioactive contamination of wounds is reviewed. The application ranges are given for proportional gas counters, scintillating detectors, cooled and uncooled semiconducting detectors, the possible measuring limits are established. 3 figs.

23643 (ISH—88, pp 17-38) **Significance of radiobiological research for the field of radiotherapy.** Fritz-Niggli, H. Mar 1986. (In German). Bundesgesundheitsamt, Neuherberg, Germany, F.R. Inst. fuer Strahlenhygiene.

In Dedicated to F.E. Stieve on the occasion of his 70th anniversary.

Radiotherapy is discussed from the point of view of a radiobiologist. The topics dealt with by the author include: the optimization of radiotherapy, - but not so much with regard to radiation protection -; radioresistance and cell kinetics; cell activation studies in vitro and in vivo; application of high-LET radiation in radiotherapy; use of selectively response-modifying factors. She also reports about the detection and recording of early and delayed radiation effects and the significance of biological repair.

23644 **(ISS-L—84/7) Radiation protection elements.** Belli, M.; Frullani, S.; Orestano, F.V.; Campurra, G. (Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica; Universita di Reggio Calabria (Italy); ENEA, Frascati (Italy). Centro Ricerche Energia). 15 Nov 1984. 99p. (In Italian). (CONF-831138—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87900284.

From International school of radiation damage and protection: biological effects and dosimetry of non-ionizing radiation; Erice, Italy (15 Nov 1983).

To acquaint personnel working in ionizing radiation fields with the risks involved in such an activity, lectures were held at the Istituto Superiore di Sanita, in November 1983, concerning biological effects of radiation, health effects of radiation, physical and medical aspects of radiation protection. Papers of the lectures are here collected.

23645 **(JINR—R-19-85-822) Mathematical model of Ehrlich ascites tumor cancerogenesis from in vitro treated cells.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701456.

Submitted to the journal Neoplasma.

Mathematical model is proposed describing the dependences of the mouse lethality and average life length on the number of Ehrlich ascites tumour (EAT) cells inoculated into mouse, both intact or treated in vitro by various agents. Particularly, the effect of ionizing radiation is discussed; the effect of combined action of two agents is considered. 6 refs.; 2 figs.

23646 **(JINR—R-19-85-824) Cell survival parameters of Ehrlich ascites tumor cells irradiated by gamma-radiation in oxygenated and anoxic conditions deduced from in vivo assays of ascites tumor cancerogenesis.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701457.

Submitted to the journal Neoplasma.

Ehrlich ascites tumour (EAT) cells have been irradiated in vitro in oxygenated or anoxic conditions. Average mouse life span and mouse lethality have been determined for various doses and various EAT cell numbers. Cell survival parameters of EAT cells are deduced from the results. 4 refs.; 5 figs.

23647 **(JINR—R-19-86-38) Irradiated cell inactivation probabilistic model: consideration of sigmoidal form of intact cell fraction dose dependence.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701458.

Submitted to the journal Radiobiologiya.

A version of irradiated cell inactivation probabilistic model is proposed taking into consideration the sigmoidal form dose dependence of intact cell fraction. Analysis of survival curves and intact cell fraction dose dependences after γ-irradiation of diploid yeast Saccharomyces cerevisiae, carried out on the base of the given approach, allows one to make the following conclusions. Values of the parameter describing the damage realization probability and determining the effect of delayed colony apperance can be calculated unambiquously and more precisely on the base of the given model version than on the base of the original one. The effect of delayed colony appearance is more stable indicator of irradiated diploid yeast response than the survival ratio. Essential variations of survival curve are determined by variations of intact cell fraction dose dependence. 9 refs.; 1 tab.

23648 **(NUREG/CR—4409-Vol.2) Data base on nuclear power plant dose reduction research projects.** Khan, T.A.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1986. Contract AC02-76CH00016. 225p. (BNL-NUREG—51934-Vol.2). NTIS, PC A10/MF A01 - GPO. File Number TI87005049.

Staff at the ALARA Center of Brookhaven National Laboratory have established a data base of information about current research that is likely to result in lower radiation doses to workers. The data base, concerned primarily with nuclear power generation, is part of a project that the ALARA Center is carrying out for the Nuclear Regulatory Commission. This report describes its current status. A substantial amount of research on reducing occupational exposure is being done in the US and abroad. This research is beginning to have an impact on the collective dose expenditures at nuclear power plants. The collective radiation doses in Europe, Japan, and North America all show downward trends. A large part of the research in the US is either sponsored by the nuclear industry through joint industry organizations such as EPRI and ESEERCO or is done by individual corporations. There is also significant participation by smaller companies. The main emphasis of the research on dose reduction is on engineering approaches aimed at reducing radiation fields or keeping people out of high-exposure areas by using robotics. Effective ALARA programs are also underway at a large number of nuclear plants. Additional attention should be given to non-engineering approaches to dose reduction, which are potentially very useful and cost effective but require quantitative study and analysis based on data from nuclear power plants. 9 refs., 1 fig.

23649 **(NUREG/CR—4856) Feasibility study on a data-based system for decisions regarding occupational radiation protection measures.** Watson, E.C.; Fisher, D.R. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Feb 1987. Contract AC06-76RL01830. 68p. (PNL—6137). NTIS, PC A04/MF A01 - GPO. File Number TI87005812.

At the request of the Nuclear Regulatory Commission (NRC), a study was conducted to determine the feasibility of developing uniform, data-based guidelines and standardized analytical techniques for deciding when specific protective measures should be used for various operations involving work with unencapsulated radioactive materials. Comprehensive reviews of radiation protection procedures and practices were conducted during site visits to each of 11 candidate NRC-licensed facilities. Only six facilities provided useful data. Release fractions and probabilities of intake based on the data collected for routine operations under somewhat quiescent conditions were determined for several different radionuclides and operations at the cooperating facilities. Five levels of radiation protection programs were developed as a guide. Within each level, threshold and ceiling values are suggested for levels of activity, concentrations of radioactive materials in air or on surfaces, and external dose rates for which protective measures might be appropriate. In the authors' opinion, a technical approach based on mathematical relationships is the most feasible approach to developing guidelines for deciding which specific protective measures are needed. However, a consensus among licensors and licensees on threshold and ceiling values for specific protective measures is needed. 22 refs., 1 fig., 9 tabs.

23650 **(OEFZS—4370) Contribution to the topic 'environmental radioactivity'.** Horak, O. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Aug 1986. 4p. (In German). (LA—164/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701590.

Reprint from Getraenke (7/8) p. 1-4 (1986).

The contamination by /sup 103/Ru, /sup 134/Cs and /sup 137/Cs due to the Chernobyl fallout in Austria is considered for the plants used in the production of wine, beer and fruit-juices. Mechanisms of nuclide migration are outlined and typical contaminations are given. (G.Q.).

23651 **(OEFZS—4377) Genetic effects of ionizing radiation and repair processes.** Tuschl, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 23p. (In German). (BL—597/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701591.

Since DNA (=desoxyribonucleic acid) is the largest molecule within the cell it is the most important target for direct and indirect radiation effects. Within DNA the total genetic information is stored, thus damage to DNA in germ cells causes genetic disorders and damage in somatic cells is implicated in cancer and immunodeficiences. Alterations of DNA structure are not only due to ionizing radiation effects, but also to spontaneous DNA modifications and damage from interactions with environmental ultraviolet light and chemical agents. To maintain its genetic integrity, each organism had to develop different repair systems able to recognize and remove DNA damage. Repeated exposure to a DNA damaging agent can even lead to adaptation processes and increased resistance to the same agent. At normal function of repair systems it can be assumed that the capacity of those systems is adequate to scope with the effects of low radiation doses.

23652 **(OEFZS—4380) Further environmental factors causing variations of SCE frequencies.** Tuschl, H.; Kovac, R.; Wottawa, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Dec 1986. 12p. (BL—602/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701593.

The frequencies of spontaneously occurring sister chromatid exchanges (=SCE) were determined in control persons, persons exposed to very low doses of ionizing radiation and employees of a rubber factory. Besides smoking habits and the usage of oral contraceptives, background ultraviolet (=UV) radiation seems to exert the most pronounced effect on SCE levels in control persons.

23653 (ORNL—6353, pp 50-54) **Repair of human DNA.** Regan, J.D.; Carrier, W.L.; Epler, J.L.; Francis, A.A.; Simms, S.I.; Stanford, B.G. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors research objectives are to analyze the various components of the human repair system and determine their impact on the carcinogenic event in man. To these ends they employ both normal, repair-proficient human cells and cells derived from patients with the hereditary, cancer-prone disease, xeroderma pigmentosum (XP) which are deficient in DNA repair. Repair in other cell types is studied whenever such experiments can contribute to the understanding of the the DNA repair process in human cells. Their primary objective is to elucidate the molecular events in human cells when DNA is damaged by radiation or chemical agents. They study and characterize the sequence of DNA repair events, the various modalities of repair, the physiological inhibition of repair due to biochemical inhibitors, and the genetic basis of repair. The authors ultimate goals are to isolate and analyze the repair component of the mutagenic and/or carcinogenic event in human cells, and to evaluate the significance of this repair component as it impinges on the practical problems of human irradiation or exposure to actual or potential chemical mutagens and carcinogens.

23654 (ORNL—6353, pp 72-74) **Dose-rate effects on the response of mouse spermatogonial stem cells to X-ray induction of heritable translocations.** Generoso, W.M.; Braden, P.G.; Cacheiro, N.L.A.; Cain, K.T.; Cornett, C.V.; Hughes, L.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The primary objective of the present study is to estimate the magnitude of risk per unit exposure. In order to make this estimate, it is essential to determine how the rate of induction is affected by the conditions of radiation exposure such as dose, dose fractionation, and dose rate. The authors are currently conducting a large project to determine the effect of varying dose rate on the induction of heritable translocations in spermatogonial stem cells. Two ^{137}Cs sources were used in the study. One group of mice was exposed to 600 rad gamma rays at 30 R/min, the other to either 150, 300, 600, or 1200 gamma rays 0.7 R/min. Each group consisted of 72 (101 x C3H)F_1 males, each of which was caged individually with an unexposed (SEC x C57BL)F_1 female 42 days after the end of the irradiation. Male offspring of matings made 60 days or longer postirradiation are being collected and tested for the presence of translocations. The study is still in progress, but the data collected up to this point already show not only an effect of varying the dose rate, but also a clear departure at low dose rate from the humped dose-effect curve the authors observed at high dose rate. Comparison of the frequencies of partially sterile translocation carriers in the two 600 R groups shows that the lower dose rate of 0.7 R/min produced about 3.5 times fewer translocations than the higher rate of 30 R/min (13/1928 or 0.67 x 10^{-2} vs 46/1945 or 2.37 x 10^{-2}).

23655 (ORNL—6353, pp 74-75) **Nature of strain differences in spermatogonial responses to radiation.** Generoso, W.M.; Cain, K.T.; Cornett, C.V.; Hughes, L.A.; Braden, P.W. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In the course of an earlier study, the authors observed a clear-cut strain difference in embryonic mortality following exposure of the father's spermatogonial stem cells to 4 x 500 R acute X rays. The overall frequency of embryonic mortality was about 23% for irradiated (C3H x 101)F_1 or (101 x C3H)F_1 males, and about 7% for irradiated (SEC x C57BL)F_1. The strains differed in the same direction, but to a lesser degree, with regard to length of the sterile period resulting from killing of stem-cell spermatogonia. To obtain some clues as to the nature of the strain differences and check further the possible relationships between cytotoxic and cytogenetic responses, they initiated experiments in which the condition of X-ray exposures was varied. In the earlier study, the four

fractions of 500 R were separated by four-week intervals. In the new study, males from the two strains were exposed simultaneously to either of the following regimens: 500 R, single dose; 2 x 500 R, 24 h between doses; 4 x 500 R, 8 weeks between doses; and 100 R + 900 R, 24 h between doses. The corresponding incidences of embryonic mortality among offspring resulting from irradiated spermatogonia (males were mated within 3 months after the recovery of fertility) are 12% and 8%, 30% and 17%, and 17% and 13%. These results show that the length of the sterile period for the two strains may differ in opposite directions depending upon the exposure regimen used, but the corresponding incidence of embryonic mortality is either similar in the two strains or clearly higher when fathers are (C3H x 101)F_1. Furthermore, within each of the two strains, the two endpoints exhibit no correlation whatsoever.

23656 (ORNL—6353, pp 75-76) **Difference between two hybrid stocks of mice in the incidence of congenital abnormalities following X-ray exposure of stem-cell spermatogonia.** Generoso, W.M.; Braden, P.W.; Cain, K.T.; Hughes, L.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Recently, the author reported that the incidence of X-ray induced embryonic lethality differed markedly between two hybrid stocks of irradiated male mice. A parallel difference in the frequencies of reciprocal translocations was observed cytologically in the meiocytes of irradiated males. In the present study, they attempted to determine whether or not similar differences between the two stocks exist for congenital defects resulting from genetic damage to stem-cell spermatogonia. Ninety-six males from each of two stocks of mice, (C3H x 101)F_1 and (SEC x C57BL)F_1, were simultaneously irradiated with 4 doses of 500 R (89 R/min) X rays given 4 weeks apart. During the interval 152-159 days after the last exposure, each surviving male was mated to three (C3H x C57BL)F_1 females. The pregnant females were killed and each live fetus was weighed. Results showed a parallelism between the frequencies of congenital abnormalities and of reciprocal translocations. The frequencies of congenital abnormalities in the X-ray groups were significantly higher than those in the respective control groups. And, while the controls of the two stocks were not significantly different from one another, the frequency of anomalies among offspring of irradiated (C3H x 101)F_1 was significantly higher than that among offspring of irradiated (SEC x C57BL)F_1. Growth retardation and neural-tube and abdominal-wall defects were the types of abnormalities most commonly observed.

23657 (ORNL—6353, pp 76-77) **Alkaline-elution measurement of DNA breakage and repair in isolated pachytene spermatocytes and spermatids after exposure to X rays.** Sega, G.A.; Generoso, E.E. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

To further study the effects of X rays on the induction of DNA strand breaks in germ cells, single-cell suspensions made from mouse testes were irradiated with 800 R of X rays. Following irradiation, pachytene spermatocytes or early spermatids were isolated from the cell suspensions using centrifugal elutriation. This procedures separates cells on the basis of their size. After isolation, the pachytene spermatocytes or early spermatids were maintained for 1 h at either 33°C (the approximate temperature of the mouse testis) or at 0°C. Following this 1 h period, the cells were lysed on polyvinyl filters, and the alkaline elution procedure was carried out to monitor DNA breakage. The results of this study showed that there was increased strand breaks from both pachytene spermatocytes and early spermatids exposed to 800 R of X rays, but this breakage was measurable only when the cells were maintained at 0°C. After 1 h posttreatment incubation at 33°C, no measurable DNA breakage could be detected with the authors alkaline elution procedures. Thus, these experiments have now shown that DNA breaks do occur in pachytene spermatocytes and early spermatids of the mouse after X-ray exposure, but that the breaks are normally rejoined very rapidly (in less than 1 h).

23658 (ORNL—6353, pp 89-90) **Structural and functional analyses of the dilute-shortear region: genetic and molecular studies.** Russell, L.B.; Rinchik, E.M.; Montgomery, C.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In earlier genetic experiments with a large number of radiation-induced mutations in the dilute-shortear (d-se) region of Chromosome 9, the authors had been able to characterize a series of presumed deletions that overlap a one or both marker loci, extending to various distances on both sides. Complementation mapping yielded a functional map encompassing at least 12 functional units. At least 27 complementation groups could be identified that encompassed two or more of these functional units. This year, the authors initiated further genetic experiments to refine the complementation map. Deletion mapping has been carried out with the gene ashen (ash), a closely linked mimic of dilute (d). Experiments with 34 mutants have been completed, and crosses with an additional 9 are in progress. Of 22 dilute-shortear (d se) mutants tested, 9 were found to be deficient also for ash, while 13 were not. Only one of 9 d/sup p1/ (prenatally-lethal dilute) and none of 3 se^1 (lethal shortear) mutations tested was deficient for ash. On the basis of these results and the prior complementation map, ash appears to be located between p1-1 and p1-2; and several of the mutations that previously were in the same complementation group can now be demonstrated to be distinct from each other. The region covered by the deletions is now known to be at least 3.3 cM in length, extending from proximal to ash to distal to sv (neuromuscular development), thus, presumably, involving approximately 5000 kb of DNA.

23659 (ORNL—6353, pp 91-92) **Exploration of methods to localize DNA sequences missing from c-locus deletions.** Albritton, L.M.; Russell, L.B.; Montgomery, C.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors have earlier characterized a large number of radiation-induced mutations at the c locus (on Chromosome 7) through genetic analysis, including extensive complementation tests. Based on this work, they have postulated that many of these mutations are deletions of various lengths, overlapping at c (the marker used in the mutation-rate experiments that generated the mutants). It was possible to apportion these deletions among 13 complementation groups and to fit them to a linear map of 8 functional units. Collectively, the deletions extend from a point between tp and c to one between sh-1 and Hbb, i.e., a genetic distance of from 6 to 10 cM, corresponding to at least 10^4 Kb of DNA. This year, the authors completed a pilot study designed to explore methods for finding DNA sequences that map to the region covered by the various c-deletions. The general plan was to probe DNA with clones derived from Chromosome-7-enriched libraries or with sequences known (or suspected) to reside in Chromosome 7. Three methods were explored for deriving the c-region-deficient DNA: (a) from mouse-hamster somatic-cell hydrids retaining a deleted mouse Chromosome 7, but no homologue; (b) from F_1 hybrids of M. musculus domesticus (carrying a c-locus deletion) by M. spretus; and (c) from F_1 hybrids of M. domesticus stocks carrying complementing deletions.

23660 (ORNL—6353, pp 93-95) **Molecular genetic analysis of regions of the murine genome associated with radiation-induced mutations.** Rinchik, E.M.; Cummings, C.C.; Johnson, D.K. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors are exploiting the large array of radiation-induced mutations to develop both detailed molecular and functional maps of selected small model regions (as opposed to specific genes) within the mouse genome. Through the integrated use of recombinant DNA technology and classical genetic and cytogenetic analysis, they hope to relate the structure and function of these regions to the study of both normal and abnormal mammalian development. Over the years, the germ-line mutagenesis program has generated a valuable array of induced mutations at several specific loci scat-

tered throughout the murine genome. Many of these mutations are multilocus deletions of chromosomal DNA. Genetic analysis of these types of lesions has detected passenger mutations of wide-ranging effect and severity, and has generated gross functional maps of entire chromosomal regions. They have initiated a program to expand the molecular analysis of these types of deletion mutations. This program exploits the deletion mutations and other chromosomal rearrangements to obtain molecular clones of wild-type DNA that map to regions absent in mutants carrying the deletions. These clones will then be used to correlate the resultant molecular/physical map of the chromosomal region with the genetic/functional map in both mutant and wild-type individuals. Such correlations are essential to a strategy for identifying as many of the genes as possible in a particular region of the genome and for ascertaining their role(s) in the normal development of the mouse.

23661 (ORNL—6353, pp 96-97) **Genetic analysis of multiple classes of Steeloid mutations: preliminaries for developmental analysis of pleiotropic effects.** Russell, L.B.; Bangham, J.W.; Carpenter, D.A.; Guinn, G.M.; Hunsicker, P.R.; Maddux, S.C.; Montgomery, C.S.; Phipps, E.L.; Stelzner, K.F. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In the past year, the authors have analyzed data (comprising about 100,000 offspring) from numerous crosses involving 60+ Steeloid (Sld) stocks. About 10% of the mutations occurred spontaneously; the remainder occurred among offspring of male or female mice exposed to various types of radiations (X rays, gamma rays, neutrons, bomb tests, internal emitters), or chemicals (ENU, MNU, EMS). At least one (and, possibly, two) additional translocations were found, one of these being of spontaneous origin. Although several intercrosses are being made among Steeloids, their first analysis involves three standard crosses made in each stock: (a) Sld/+ (of either sex) x +/+ (C3H/sub f/); (b) Sld/+ x Sld/+ (sibs); and (c) Sld/+ x Sl/su 1XY//+ (one of the translocation mutants, chosen because it is homozygous viable, black-eyed white). The last of these crosses is essentially on allelism test. At least four of the Steeloids have, to date, failed this test and may be mutations at one or more other loci. Homozygotes of all four of these mutants survive well past birth and have very little of no hair pigment but probably fully pigmented eyes.

23662 (ORNL—6353, pp 97-99) **Analysis of time of death of prenatally lethal Steeloid mutations.** Rinchik, E.M.; Cummings, C.C.; Bangham, J.W.; Hunsicker, P.R.; Phipps, E.L.; Stelzner, K.F. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Deletion mutations have been extremely useful in initiating the functional and molecular dissections of regions of the mouse genome. For the d-se and c regions, for example, it was observed that radiation mutations carrying lethal factors separable, by complementation analysis, from the primary d, se, or c mutation itself, could often be associated at both the genetic and molecular levels with multilocus chromosomal deletions. Since many of the Oak Ridge Sld mutations arose in radiation mutagenesis experiments, a substantial number may carry chromosomal deletions that involve the Sl locus in chromosome 10. Because of the great value of deletion mutations for the genetic and molecular analysis of chromosomal regions and complex genetic loci, they have initiated a series of experiments designed to test whether radiation-induced Sld mutations carry other lethal factors, in addition to the lethality caused by severe alleles of the Sl locus itself, as one prescreen for identifying Sld's that are caused by deletions.

23663 (ORNL—6353, pp 105-106) **Cytological studies of sterility in male progeny of mutagen-exposed male parents.** Cacheiro, N.L.A.; Cornett, C.V. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Genetic male sterility results primarily from certain types of balanced reciprocal translocations, and, more rarely, from certain numerical sex-chromosome anomalies. Sterile male offspring sired following exposure of male meiotic or postmeiotic stages to radiation or chemical mutagens are not uncommon and are predominantly carriers of balanced translocations. The chromosome breakpoints of these translocations are generally located near the ends of autosomes or anywhere in the sex chromosomes. Sterile offspring from mutagen-treated spermatogonial stem cells, on the other hand, are not only rare but most of them have no readily detectable chromosomal anomalies. Those that have are either carriers of balanced translocations, or are sex-chromosome trisomics or mosaics (XYY, XXY, XY//XYY, XO//XY, etc.). The nature of the exchange in spermatogonia-derived sterile translocations is not clear and awaits detailed study. In addition, the data base is not yet sufficient for determining the role of induced nondisjunction in the production of genetic male sterility. Accordingly, they have an ongoing project that attempts to study associations between the nature of genetic fertility impairments and the detailed chromosomal genotype, and between chromosomal causes of sterility and the nature of mutagenic treatments that produce them.

23664 (ORNL—6353, pp 123-131) **Radiation carcinogenesis.** Ullrich, R.L.; Fry, R.J.M.; Storer, J.B.; Terzaghi-Howe, M.; Allen, B.E.; Bowles, N.D.; Jernigan, M.C.; Lee, W.H.; McKarns, S.C.; Ogle, S.P.; Satterfield, L.C. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The radiation carcinogenesis research program encompasses studies of the carcinogenic effects of ionizing radiations as well as ultraviolet radiation. Research continues to emphasize neutron carcinogenesis, dose response and time-dose relationships, the dynamics of the carcinogenic process after exposure to radiation and/or chemical, and the role of host factors (e.g., cell-cell communications, growth factors, genetic background, and the immune system) in tumor development. These problems are being approached by the in vitro and in vivo/in vitro methods. The scope of the research is greatly facilitated because of numerous collaborative research efforts with other investigators within the division and with investigators outside the division. The examination of mechanisms and the establishment of general principles which may allow an understanding of risks to humans from radiation exposure is a common emphasis among all the research projects described. Data from these studies are also being used to try to develop methods of extrapolation of animal data to human risks.

23665 (ORNL—6353, pp 135-136) **Cytometrics.** Hand, R.E. Jr. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The Cytometrics group concentrates its activities mainly on work that is related to the operation of a state-of-the-art multi-user facility for flow cytometry (FCM) and cell sorting. Experiments with mouse bone marrow and ML-1 myelogenous leukemia cells were performed. After X-ray irradiation, phase fractions of the cell cycle were determined by FCM and correlated with chromosomal aberrations. ML-1 cells were found to have a greater radiosensitivity, hence more chromosomal aberrations, than the normal mouse bone marrow cells. A delay in progression from the G0/G1- to S-phase in the normal mouse bone marrow allowed for DNA repair and fewer aberrations. This delay was not seen in the ML-1 cells. FCM and cell sorting was used in a study to determine the level of 6-methylguanine repair in C3H/10T1/2 cells by measuring the enzyme 6-methylguanine-DNA methyltransferase (MGMT). With FCM the phase fractions of the cell cycle were monitored so that accurate measurements of MGMT activity could be correlated to the phases of the cell cycle. If cells were treated with MNNG to induce lesions in the DNA, there was a significant reduction in the MGMT activity at the onset and during S-phase. Recovery of MGMT activity was delayed until the onset of the G2-phase of the cell cycle. FCM and cell sorting was also applied to a unique problem involving algae.

23666 **(PNL—5960) Characteristics of beta detection and dose measurement at Department of Energy facilities.** Mulvehill, J.M.; Brackenbush, L.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 59p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006879.

This report considers the current state of the art of beta dosimetry practices and beta detection methods used by health physicists at US Department of Energy facilities. This information is based on a survey of DOE facilities. Beta measurements are technically difficult and innovative efforts must be expended to improve their accuracy. Perhaps the most pronounced problem is that beta dosimetry and instrumentation in use are highly energy and angular dependent. Many believe that beta exposures are adequately controlled because beta to photon ratios are assumed to be low. This assumption is not always valid as demonstrated by the accident at Three Mile Island (TMI). Significant beta doses exist where personnel are exposed to mixed fission products; for example, chemical reprocessing plants, reactor accidents, or where uranium metals are processed. This report is part of an effort to increase the DOE response to this technically difficult area of health protection. Problem areas are addressed and methods recommended to improve beta dosimetry through a cooperative effort among the various DOE contractors. 34 refs., 2 figs., 16 tabs.

23667 **(PNL-SA—14591) Status of phenomenological modeling.** Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 4p. (CONF-870163—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87004922.

From DOE/CEC workshop on mechanisms of radiation interaction with DNA; San Diego, CA, USA (21 Jan 1987).

Mathematical models serve two primary functions, to provide the means for estimating the effects of exposures which fall outside the range which can be investigated directly, and to form a framework for organizing observations so that the patterns and eventually the underlying mechanisms can be determined. The response of cells to acute irradiation as a function of dose can be described rather easily. Many different mathematical expressions fit the observed data within the experimental uncertainties. However, the regions of dose and dose rate which are of concern in radiation protection are far below the doses and dose rates generally used in experimental studies. The small errors remaining in even the best experiments translate into large uncertainties at the doses of interest. Thus purely phenomenological models (avoiding explanation or interpretation) cannot be totally successful in justifying the extrapolation. One is forced to look at general characteristics of mechanisms in order to justify the use of the models. If the model can be established independently then the shape of the dose response curve is known and extrapolations can be made with confidence even though some uncertainty remains about the values of coefficients.

23668 **(RERF-TR—9-84) Life table analysis with small numbers of cases. An example; multiple myeloma in Hiroshima and Nagasaki.** Hoel, D.G.; Jennrich, R.I. (Radiation Effects Research Foundation, Hiroshima (Japan)). Oct 1984. 12p. (In Japanese and English). NTIS (US Sales Only), PC A02/MF A01. File Number DE86780549.

Life table analysis techniques in epidemiology depend upon the asymptotic properties of the statistical test methods employed. In some instances, the statistical procedures indicate highly significant results which are, in reality, unjustified. This phenomenon may occur when the asymptotic methods are applied in situations where the cases of interest are few in number. This situation is illustrated by the 20 multiple myeloma deaths observed in the RERF Life Span Study cohort. A permutation test is applied to the life table data, although the test requires the false assumption that the censoring distribution is independent of the radiation dose. A simulation test is developed which does not require equal censoring, which has the same asymptotics as the usual test methods, and which is less likely to overestimate significance in small samples. It is found that both of these small-sample tests provide reasonable numerical solutions. In addition, the simulation test is recommended in general for analyzing life table data with unequal censoring. Finally, by using the small-sample tests, the frequency of death from multiple myeloma is shown to be positively associated with radition dose ($P < 0.01$).

23669 **(SIS—1986:4) Measurements of cesium-137 in Norwegian Lapps from the Kautokeino area during the Spring 1986. Measurements of cesium-137 in reindeer meat from the Kautokeino reindeer slaughterhouse.** Gjertsen, L.; Lind, B. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 12p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750690.

Owing to large consumption of reindeer meat, the reindeer-herding Lapps represent the Norwegian section of population receiving the highest radiation doses from /sup 137/Cs due to fallout from nuclear weapon tests. Measurements performed during the spring 1986 show an average body burden of /sup 137/Cs in Lapps corresponding to a whole-body irradiation of 11 mrad/year for men, and 8 mrad/year for women. The average /sup 137/Cs activity in reindeer meat from the Kautokeino area amounts to 263 Bq/kg.

23670 **(SSI—86-11) Measurement of individual doses annual report 1985.** Kiibus, A. (National Inst. of Radiation Protection, Stockholm (Sweden)). 13 Jun 1986. 9p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750704.

The recorded doses have been divided into groups covering X-rays, gamma and beta radiation and medicine (health care) techniques (industrial use) and research respectively. (G.B.).

23671 **Experience in the practical application of biological indicators. Appendix 1. The REAC/TS registries status.** Fry, S.A.; Sipe, A.H. (Oak Ridge Associated Universities, Inc., TN). pp 35-38 of Biological indicators for radiation dose assessment. Kaul, A.; Dehos, A.; Boegl, W.; Hinz, G.; Kossel, F.; Schwarz, E.R.; Stamm, A.; Stephan, G. (eds.). Muenchen, Germany, F.R.; MMV Medizin Verl. (1986). (CONF-8312147—).

From International workshop on biological indicators for radiation dose assessment; Reisensburg, F.R. Germany (12 Dec 1983).

To date, a total of 188 radiation accidents has been recorded in the REAC/TS registries; 133 of those accidents occurred in the United States. Of the total, 16 accidents (one since 1965) were associated with critical excursions, 124 were associated with radiation devices, primarily commercial radiation sources (87 accidents) and X-ray devices (30 accidents), and 48 were associated with the use of unsealed radioisotopes in industrial, research, and medical environments. A total of 928 individuals has been involved in these accidents in some way (767 in the United States). The cumulative status of the registries, as of October 1, 1983, is shown. 142 figures, 61 tables.

23672 **Experience in the practical application of biological indicators. Appendix 2. DOE-REAC/TS radiation accident registries: Serious radiation accidents worldwide. A selected bibliography.** Fry, S.A.; Sipe, A.H. (Oak Ridge Associated Universities, Inc., TN). pp 39-56 of Biological indicators for radiation dose assessment. Kaul, A.; Dehos, A.; Boegl, W.; Hinz, G.; Kossel, F.; Schwarz, E.R.; Stamm, A.; Stephan, G. (eds.). Muenchen, Germany, F.R.; MMV Medizin Verl. (1986). (CONF-8312147—).

From International workshop on biological indicators for radiation dose assessment; Reisensburg, F.R. Germany (12 Dec 1983).

The bibliography contains 92 items. 142 figures, 61 tables.

23673 **Neutron effects in humans: Protection considerations.** Fry, R.J.M. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Nuclear Science Applications;* 2: No. 3, 397-407(1986). Contract AC05-84OR21400.

The International Commission on Radiological Protection (ICRP) has recommended that the Quality Factor for neutrons should be changed from 10 to 20. The author reviews the Quality Factor for neutrons and illustrates many of the problems that the selection of protection standards pose.

23674 Study of RBE of Cf-252 of hemopoietic tissue and PLD-like effect of magnetic fields by CFU-S assay. Maruyama, Y.; Magura, C.; Feola, J. (Univ. of Kentucky Medical Center, Radiation Therapy Oncology Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 771-779(1986).

The RBE of Cf-252 (Cf) neutron irradiation was determined for hemopoietic tissue using spleen CFU-S. Radiosensitivity was compared to acute Cobalt-60 radiation and low dose rate (LDR) Cesium-137 under identical irradiation conditions. No dose rate effect was observed for hemopoietic CFU-S to acute or low dose rate photon irradiation. The RBE for CFU-S irradiated with Cf-252 either in vivo or in vitro was 2.1 for the neutron component of Cf irradiation. Potentially lethal damage (PLD) was studied for endogenous CFU-S using pulsating magnetic fields. Changes consistent with PLD-like effects were noted for Cf and acute Co-60 but not for LDR Cs-137 for the CFU-S.

23675 Response of lymphoid organs to low dose rate Cf-252, Cs-137 and acute Co-60. Feola, J.; Maruyama, Y.; Magura, C.; Hwang, H.N. (Radiation Medicine, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 787-796(1986).

RBE of low dose rate (LDR) /sup 252/Cf radiation was studied for thymus using weight loss compared to unirradiated controls. These were compared against LDR /sup 137/Cs and acute / sup 60/Co effects. For thymus, biexponential dose response curves were noted for acute /sup 60/Co and LDR /sup 137/Cs irradiations. No dose rate effect was noted with /sup 137/Cs. D/sub 37/ for the first component D/sub 1/ was 109 cGy and for the second D/sub 2/ was 624 cGy for /sup 60/Co. Relative biological effectiveness (RBE) is a complex endpoint and was different for the low dose (sensitive) and high dose (resistant) responses and for /sup 252/Cf. RBE/sub n/ of the sensitive portion was 1.7 and for overall was 4.0. Spleen response was also determined for the 3 radiations. Biexponential dose-response curves were also observed for resting spleen to acute /sup 60/Co and LDR /sup 137/Cs radiation. D/sub 1/ = 285 cGy and D/sub 2/ = 1538 cGy for acute / sup 60/Co; D/sub 1/ = 205 cGy for /sup 137/Cs and indicated a dose rate effect = 1.04 for /sup 137/Cs. The LDR /sup 137/Cs was 1.3x more effective than acute /sup 60/Co for the sensitive response; it was 1.9 x greater for the resistant response. However, the response to /sup 252/Cf vs. /sup 137/Cs for the spleen indicated that there was a greater sensitivity to dose rate than to LET. RBE/ sub n/ for /sup 252/Cf vs. /sup 137/Cs was 1.0. Stimulation of spleen growth after injection of Corynebacterium parvum allowed study of radiation effects of proliferating spleen cells at day 10. Acute /sup 60/Co and LDR /sup 137/Cs γ-rays had reduced effects compared to LDR /sup 252/Cf radiation and RBE was 4.0 vs. LDR /sup 137/Cs. RBE in lymphoid organs thus depended on organ, on assay and on resting/proliferating status.

23676 Comparative biological effects of low dose, low dose-rate exposures to fission neutrons from the JANUS reactor or to Co-60 gamma rays. Grahn, D.; Thomson, J.F.; Carnes, B.A.; Williamson, F. (Div. of Biological and Medical Research, Argonne National Lab., Argonne, IL 60439). *Nuclear Science Applications;* **2**: No. 3, 385-396(1986).

The National Council for Radiation Protection (NCRP) in the United States and the National Radiological Protection Board (NRPB) of the United Kingdom have both issued advisories regarding the possibility that the value of Q for occupational exposures to neutrons may be low by a factor of 2 or 3. The situation and the uncertainties have been summarized in another work. This paper updates some of the data reviewed in that study, specifically the present status of the long-term studies in neutron radiobiology being carried out at the Argonne National Laboratory (ANL) using the JANUS reactor as the source of fission neutrons.

23677 The response of mouse jejunal crypt cells to Cs-137 gamma rays and Cf-252 neutron irradiation. Coffey, C.W.; Meece, D.; Beach, J.L. (Dept. of Radiation Medicine, Radiation Therapy Oncology Center, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 749-755(1986).

Male CD/sub 2/F/sub 1//HAP mice were exposed to similar doses from Cs-137 and Cf-252 linear source arrays using a ferris wheel irradiator. The Cs-137 γ-ray dose rate was 87.2 cGy/hr as determined by TLD dosimetry. A paired ionization chamber measurement technique was utilized to evaluate the Cf-252 dose rate; i.e. 14.4 cGy/hr neutron and 6.5 cGy/hr gamma rays (n/γ ratio = 2.22). Jejunal crypt scoring criteria followed those established by a previous study. These experiments show that RBE in small bowel was high using microcolony assay. Analysis of crypt survival curves yielded a RBE for Cf-252 neutrons of approximately 6.0 for small bowel in agreement with data reported by the earlier study.

23678 Micronuclei in bone marrow cells of BALB/c mice irradiated with Cf-252 or Co-60. Goud, S.N.; Feola, J.M.; Maruyama, Y. (Dept. of Radiation Medicine, Univ. of Kentucky Medical Center, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 781-785(1986).

In the present investigation, Cf-252, a mixed neutron and gamma emitter, was studied using a simple and sensitive assay called the micronucleus (MN) test. The mice were exposed to whole body radiation from Cf-252 (10-60 cGy) or Co-60 (20-120 cGy) and scored for the presence of micronuclei in polychromatic erythrocytes (PCE) 24 hours after irradiation. The results indicate the relative biological effectiveness (RBE) of Cf-252 to be 2.1 compared to Co-60 gamma rays. When only the neutron component was considered the RBE/sub n/ was 2.6.

23679 Testis weight loss following low dose rate (LDR) Cf-252, acute Co-60 or LDR Cs-137 irradiation in BALB/c mice. Raju, P.I.; Hwang, H.N.; Feola, J.; Maruyama, Y. (Univ. of Kentucky Medical Center, Dept. of Radiation Medicine, Lexington, KY). *Nuclear Science Applications;* **2**: No. 3, 797-802(1986).

Mouse testis weight loss was measured with time after irradiation using Cf-252, Co-60 and low dose rate Cs-137 radiations. Testes weights were determined between days 5-45 after using large and small dose fraction irradiation. The doses selected were on the sensitive slope of the organ weight loss curve or the less sensitive portion of the curve. From these data the authors estimated the overall RBE for Cf-252 (Neutron + Gamma) to be 4.0 and 5.5 for neutrons only.

23680 Mucociliary clearance and particle retention in the maxillary and ethmoid turbinate regions of beagle dogs. Whaley, S.L.; Wolff, R.K.; Muggenburg, B.A.; Snipes, M.B. (Inhalation Toxicology Research Institute, Albuquerque, NM). *Journal of Toxicology and Environmental Health;* **19**: No. 4, 569-580(1986). Contract AC04-76EV01013.

In this study, the retention and clearance of particles instilled onto the epithelium at two sites in the nasal cavity were examined. Polystyrene microspheres (3 μm geometric diameter) were labeled with ^{141}Ce or ^{85}Sr and instilled simultaneously on the maxillary and ethmoid turbinates of beagle dogs. The retention and clearance patterns of the microspheres were followed for 30 d after instillation. Tissue samples, excreta content, and autoradiography of the radiolabels provided the basis for defining the fate of the microspheres or the radiolabels dissolved from the microspheres. Early nasal mucus velocity was significantly faster from the maxillary turbinate region than from the ethmoid turbinate region. Retention at both instillation sites at 30 d after instillation was approximately 0.1% of the amount initially instilled. Radioactivity was excreted primarily via the feces during the first few days. Radiolabel measured in urine and tissues other than turbines was small, indicating minimal dissolution of the radiolabel from the particles. Autoradiographs of turbinate tissue revealed particles sporadically located in the epithelial submucosa. From these data, it was concluded that a significant difference in early clearance for particles exists between the ethmoid and maxillary turbinates, but there was no difference in the fraction of particles retained in these two areas for long periods of time.

23681 **Radioprotection of colony forming units-spleen against heavy charged particle damage by WR 2721.** Javed Afzal, S.M.; Mahlmann, L.J.; Prioleau, J.; Ainsworth, E.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 37 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—).

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

WR2721 is known to protect a wide range of normal tissues against low LET radiation damage. Recently, protection against fission neutron damage to the gastrointestinal tract by thiophosphates was also demonstrated. The present study was undertaken to determine the LET dependence of the radioprotective effect of WR2721 on CFU-S using heavy charged particles. Donor CB/sub 6/Fl mice were given total body doses of /sup 40/Ar (330 MeV/μ) or /sup 28/Si (670 MeV/μ) ions in the plateau region of the Bragg curve 30 minutes after an IP dose of 400 mg/kg of WR2721. Marrow collected 30 to 90 minutes after irradiation was transplanted into supralethally irradiated syngeneic recipients and the CFU-S survival curves were computed. Results from replicate experiments with / sup 40/Ar ions (LET — 130 keV/μm) show WR 2721 produced a significant increase in the D/sub 0/ and a DMF of 1.2. Preliminary results with /sup 28/Si ions (LET — 50 keV/μm) indicate a DMF greater than 1.2. Additional experiments are in progress and DMF estimates for /sup 28/Si and /sup 20/Ne ions are presented.

23682 **Protein synthesis and sublethal damage repair in synchronized CHO cells.** Yezzi, M.J.; Tobias, C.A.; Blakely, E.A. (Biology and Medicine Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 43 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—). Contract AC03-76SF00098.

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

The authors have previously reported that the split dose survival response to x-rays of asynchronous CHO-TSH1 cells is reduced if the cells are held at 40°C,a temperature that inhibits protein synthesis, for 2 hours before the first dose and during a 2-hour interval between doses. In conjunction with the survival experiments on asynchronous cells, the authors also examined the DNA rejoining ability in split dose studies with and without inhibition of protein synthesis. The results of these experiments suggest that inhibition of protein synthesis affects a pool of proteins that are necessary for the correct expression of the DNA, although they do not appear to be involved in rejoining DNA breaks. They have extended this work to the study of cells synchronized in G1 phase (2 hour post-mitosis) and S phase (10 hour post-mitosis). Autoradiographic analyses, using 3H-TdR pulse labeling, demonstrated that a delay in the progression of each synchronized cell population occurs after inhibition of protein synthesis. Data are reported on the effects of inhibition of protein synthesis on the ability of G1 and S phase cells to repair sublethal damage.

23683 **Cell cycle variation in x-ray survival for cells from spheroids measured by volume cell sorting.** Freyer, J.P.; Wilder, M.E.; Raju, M.R. (Los Alamos National Lab., Los Alamos, NM 87545). pp 44 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—).

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

Considerable work has been done studying the variation in cell survival as a function of cell cycle position for monolayers or single cells exposed to radiation. Little is known about the effects of multicellular growth on the relative radiation sensitivity of cells in different cell cycle stages. The authors have developed a new technique for measuring the response of cells, using volume cell sorting, which is rapid, non-toxic, and does not require cell synchronization. By combining this technique with selective spheroid dissociation,they have measured the age response of cells located at various depths in EMT6 and Colon 26 spheroids. Although cells in the inner region had mostly G1-phase DNA contents, 15-20% had S- and G2-phase DNA contents. Analysis of these cells using BrdU labeling and flow cytometric analysis with a monoclonal antibody to BrdU indicated that the inner region cells were not synthesizing DNA. Thus, the authors were able to measure the radiation response of cells arrested in G1, S and G2 cell cycle phases. Comparison of inner and outer spheroid regions, and monolayer cultures, indicates that it is improper to extrapolate age response data in standard culture conditions to the situation in spheroids.

23684 **"Thin-Down" in radiobiology.** Katz, R. (Univ. of Nebraska, Lincoln, NE 68588-0111). pp 28 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—).

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

Experiments at GSI, Darmstadt, with spores, yeast, and mammalian cells display results characteristics of the thin-down of the tracks of heavy ions in nuclear emulsions as they approach the end of their range. The extrapolated cross-sections for inactivation are plotted against LET for ions up to uranium. The cross-sections increase to a maximum and then decline, giving the appearance of a set of hooks in the plotted graphs. This behavior, predicted a decade ago, clearly demonstrates that the inactivation is from delta-rays, with the cross-section limited by kinematic constraints on the energy of delta rays, in the "track-width regime." The authors display theoretical calculations, specific to each cell line, made from parameters fitted to the grain-count regime, to predict response in the track width regime.

23685 **Acute and chronic protection by WR2721 of rat parotid gland weight and function.** Menard, T.W.; Izutsu, K.T.; Ensign, W.Y.; Keller, P.J.; Morton, T.H.; Truelove, E.L. (Univ. of Washington, Seattle, WA 98915). pp 37 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—).

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

Changes in rat parotid gland weight and functional parameters were compared at 8-10 and 32-35 days post-irradiation in WR2721 protected and non-protected animals following exposure to a 15.3 Gy dose of Cs-137 irradiation to the head. Functional parameters were evaluated in addition to gland weight since xerostomia following tumoricidal doses of radiotherapy for head and neck cancer is largely due to inadequate fluid production by the salivary glands. Functional endpoints included maximum secretion rate, total volume and time of secretion following pilocarpine stimulation. Relative protective factors (RPF) were computed for irradiated protected and non-protected animals compared to their sham-irradiated, pair-fed controls. The RPF at 8-10 days post-irradiation were: gland weight 1.9, flow rate 2.9, volume 2.1 and time 2.1 (mean RPF 2.25). At 32-35 days post-irradiation WR2721 demonstrated a continued level of gland protection (mean RPF 1.98). The lower mean RPF was due to decreases in functional parameters. While the RPF for gland weight increased to 2.7, that for functional parameters each decreased: flow rate 2.6, volume 1.4 and time 1.2. The mean RPF for functional parameters only were 2.4 and 1.7 at 8-10 and 32-35 days respectively. The functional endpoints(s) most clinically relevant remain(s) to be determined. The overall degree of protection seen at both time periods supports the hypothesis that WR2721 may be of benefit in maintaining salivary gland function for patients undergoing radiotherapy for head and neck tumors.

23686 **Longevity of irradiated burros.** Lushbaugh, C.C.; Brown, D.G.; Frome, E.L. (Oak Ridge Associated Universities, Oak Ridge, TN). pp 42 of Abstracts of papers for the thirty-second annual meeting of the Radiation Research Society. Philadelphia, PA; Radiation Research Society (1984). (CONF-8403123—). Contract AC05-76OR00033.

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

The unique radioresistance of burros has resulted in a large-animal life-span study that began in 1951. During the course of radiation exposures, some animals at three low exposures to gamma

photons survived (10, 10, and 9 exposed to 320, 425, and 545 R, respectively). In 1953, 20 burros exposed to 375 R (gamma) in 25-R/wk increments were added to this life-span study. In 1957, 33 burros exposed to mixed neutron-gamma radiation from nuclear weapons were added. Six burros exposed to 180 rads of neutron and gamma radiation (4:1) in a "Godiva-type" reactor were added in 1959 along with 22 controls. In the first 4 years after the single gamma exposures (320-545 R), there were deaths from pancytopenia and thrombocytopenia). Afterward, however, all deaths have been attributable to common equine diseases; none from malignancies. Today, 20 of the original 112 burros in these studies survive (13 irradiated and 7 controls). Survival curves determined for unirradiated and neutron-gamma and gamma-only irradiated burros show significant differences. Median survival time: controls, 28 yrs; gamma irradiation, 26 yrs; neutron-gamma irradiation, 23 yrs. A Weibull probability analysis predicts maximum life-span to be 42 yrs.

5602 Thermal Effects

23687 (ORNL—6353, pp 16-20) **Theoretical and applied cryobiology.** Mazur, P.; Schneider, U.; Cole, K.W.; Hall, J.W. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The purpose of the Theoretical and Applied Cryobiology program is to determine the responses of cells to the major cryobiological variables involved in freezing and thawing such as cooling rate, and to the physical state of the cell and its surroundings. Besides freezing studies per se, the authors research involves a combination of experimental and mathematical approaches to determine the permeability and osmotic responses of cells to critical solutes and water. The cells currently under study are mouse embryos, Drosophila embryos, and human erythrocytes.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 22161, 22176, 22177, 22179, 22305, 23143, 23422, 23523, 23561, 23572, 23617, 23653, 23661, 23663

23688 **(BNL—39351) Ozone production at the National Synchrotron Light Source.** Weilandics, C.; Rohrig, N.; Gmur, N.F. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007642.

Ozone production by synchrotron radiation as a function of power density in air was investigated using a white beam at the BNL National Synchrotron Light Source (NSLS) x-ray ring. Power densities were calculated from the energy spectrum at 2.52 GeV. Ozone concentrations in small beam pipes were measured for power densities between $I = 10^{12}$ and 10^{15} eV . cm^{-3} . sec^{-1}. The measured ozone half-life was 37 +- 2 min. The measured G-value was 2.69 +- 0.14 mol/100 eV and the ozone destruction factor k was less than 7×10^{-19} cm^3 . eV^{-1}. The random uncertainties stated are approximately one standard error. The large departure of the values for G and k from previous values suggest that some undiscovered systematic error may exist in the experiment. Ozone concentration in excess of the 0.1 ppM ACGIH TLV can be generated in the experimental hutches but can readily be controlled. Industrial hygiene aspects of operation and possible control measures will be discussed. 19 refs., 7 figs., 3 tabs.

23689 **(CONF-8606161—2) Action of tumor initiators and promoters in the Syrian hamster embryo cell transformation assay.** Jones, C.A.; Huberman, E. (Argonne National Lab., IL (USA)). Jun 1986. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004968.

From 2. annual DOE contractors meeting on health and environmental effects of complex chemical mixtures; Delavan, WI, USA (16 Jun 1986).

The Syrian hamster embryo (SHE) cell transformation assay is unique among the rodent fibroblast transformation systems in that it uses normal, diploid cells. Alteration in the control of growth in carcinogen-treated cultures is used to indicate the onset of neoplastic development. An evaluation of the SHE assay for screening carcinogens is reported. Using coded chemicals, the degree of intra- and interlaboratory reproducibility with the system was evaluated. Overall, there was a good qualitative correlation between the carcinogenicity of the chemicals and their ability to induce morphological cell transformation. Unfortunately, the low level of response and lack of good dose-response relationships with certain chemical are still major constraints to the use of this system in routine testing. Further consideration needs to be given to developing procedures that select for, or amplify, expression of the transformed phenotype. 9 refs., 2 figs., 1 tab.

23690 (ORNL—6353, pp 13-15) **Studies on renal transport systems in a line of cultured kidney cells, LLC-PK_1.** Cook, J.S.; Dawson, W.D.; Shaffer, C.J. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The inhibition of amiloride analogs of Na^+-dependent hexose uptake in LLC-PK_1/Cl4 cells is described. Hexose-transport inhibition does not appear to be secondary to other known effects of the amilorides. Inhibition by all analogs is enhanced when they are tested in low Na^+ medium. More detailed kinetic analysis of inhibition by 5-(N-ethyl-N-isopropyl)amiloride shows it to be competitive with Na^+ with a Ki of 70-11-μM. It is concluded that the amilorides are acting directly on the hexose transporter. In addition, the retrieval of protein kinase C from a cytosolic fraction of LLC-PK_1 cells by TPA-treated cell membranes and synthetic liposomes is investigated. To study further the redistribution of protein kinase C in the cells, the clearance of PKC from the cytosolic fraction by isolated LLC-PK_1 cell membranes is investigated.

23691 (ORNL—6353, pp 20-23) **Enzyme regulation.** Jacobson, K.B.; Flanagan, J.M.; Wright, E.B. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The mechanisms involved in the resistance of organisms to toxic metals have been investigated. Earlier studies have shown that the resistance trait could be located on the X-chromosome. Genetic studies were performed by cross-over experiments involving genetic markers on the X-chromosome. The cadmium-resistance gene has been located to a region where the forked locus occurs. It has been assumed that metallothionein plays a major role in determining resistance. A hypothesis to explain the function of the cadmium-resistance gene is that this locus regulates the activity of the metallothionein gene of chromosome 3. In addition, the effect of Alzheimer's Disease on the elemental composition of the brain was investigated. An attempt was made to determine whether aluminum is altered in Alzheimer's and whether any other element is altered in human brains as a function of age and Alzheimer's Disease.

23692 (ORNL—6353, pp 23-26) **Molecular mechanisms of mutagenesis and DNA repair.** Mitra, S.; Foote, R.S.; Boulden, A.N.; Dunn, W.C.; Sikpi, M.; Sloop, F.V.; Tano, K. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Most organisms including man have evolved ways to handle damage produce in DNA by environmental agents including chemical mutagens and carcinogens. The process of repair of some types of damage is highly regulated in a tissue and cell line-specific fashion and varies from organism to organism. Thus, the ultimate biological effects of the lesions depend not only on the extent of their formation but on the efficiency of their removal as well. The research objectives of this laboratory are to elucidate the mechanism and regulation of repair of damage in DNA produced by simple alkylating mutagens and carcinogens, as well as the mutagenic changes in DNA produced as a result of persistence of unrepaired lesions. Specifically, the current topics of the authors research are (1) to elucidate the enzymatic mechanism of the human repair enzyme, DNA-O^6-methylguanine methyltransferase, and to determine the molecular mechanism of its regulation and (2) to study the nature of mutations induced by the presence of alkylated bases and

ionizing radiation-damaged bases in DNA using shuttle plasmids that replicate both in human cells and E. coli. The following report on last year's experiments bear upon the first objective.

23693 (ORNL—6353, pp 54-57) **Mammalian biochemical genetics.** Popp, R.A.; Popp, D.M.; Shinpock, S.G.; D'Surney, S.J.; Gallager, J.F.; Niemann, S.L.; Sozer, A.C.; Wawrzyniak, C.J. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The principal aim of these studies is to evaluate hazards to humans of exposure to nuclear and chemical by-products of energy production. An ethylnitrosourea-induced hemoglobin mutation (Hbb-s2) has been used to study beta-globin gene expression. Mice are used as experimental animals but the data obtained are analyzed with respect to potential hazards to man. Techniques of molecular biology and genetic engineering are used to understand the mechanisms of mutations and the effects of specific mutations on health and reproduction. Summaries of these studies are included.

23694 (ORNL—6353, pp 68-70) **In-depth study of chemical mutagenesis in mouse germ cells using N-ethyl-N-nitrosourea (ENU) as a model mutagen.** Russell, W.L.; Bangham, J.W.; Carpenter, D.A.; Co,kinias, T.L.; Feezell, J.G.; Guinn, G.M.; Hunsicker, P.R.; Montgomery, C.S.; Phipps, E.L. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors have studied the mutagenesis of ethylnitrosourea in mice germ cells by exposing spermatogonia to repeated very low does of ENU. It was determined that a threshold dose for ENU in stem-cell spermatogonia must be below 5 mg/kg. The effect of age and sex on ENU-induced mutation frequency was also investigated. The relation of ENU effect to DNA replication was evaluated in young male mice. It was determined that ENU is most effective at the time of DNA replication. In addition, the possible relation of ENU effect to O^6-G alkyl transferase was investigated.

23695 (ORNL—6353, pp 70-71) **Dose-rate effect of ethylene oxide inhalation exposures on DNA breakage in mouse spermatids.** Sega, G.A.; Generoso, E.E. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Experiments were performed to determine if the amount of DNA breakage in mouse spermatids exposed to EtO is altered by different rates of exposure. To assay for DNA breakage, an alkaline elution procedure was used. For each experiment, one group of $(C3H \times BL10)F_1$ male mice had their germ-cell DNA pre-labeled with ^{3}H-thymidine and were subsequently exposed to EtO. A second group of males had their germ-cell DAN pre-labeled with ^{14}C-thymidine and served as controls. Nine days following EtO exposure, spermatozoa from the vasa deferentia of treated and control animals were place together on a polycarbonate filter and lysed. Any small pieces of single-stranded DNA resulting from breakage by the EtO pass rapidly through the filter, while normal-sized DNA takes considerably longer to pass through. The amounts of treated and control DNA eluted were then determined using liquid scintillation counting techniques. The mice were given inhalation exposures of EtO at three different dose rates, but the total exposure was fixed at 1800 parts per million (ppm) -h. The rates of exposure were: 1800 ppm for 1 h, 900 ppm for 2 h, and 450 ppm for 4 h. The results showed that with an exposure of 1800 ppm for 1 h the amount of DNA eluted from the sperm cells of EtO-exposed animals was 36%. With an exposure of 900 ppm for 2 h, 22% of the treated sperm DNA eluted; and with 450 ppm for 4 h, 16% of the treated sperm DNA eluted. Thus, the amount of DNA breakage in mouse spermatids after inhalation exposures to EtO is clearly affected by the rate at which the animals are exposed to the chemical.

23696 (ORNL—6353, pp 71-72) **Dose-rate effect of ethylene oxide inhalation exposures on unscheduled DNA synthesis in mouse spermatids.** Sega, G.A.; Brimer, P.A.; Generoso, E.E. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

To further assess the relationship between DNA damage in mammalian germ cells and the rate at which fixed total chemical exposure is administered, a study was of the unscheduled DNA synthesis (UDS) induced in mouse spermatids by different concentrations and times of exposure of ethylene oxide (EtO) gas. Male mice were given inhalation exposures of EtO gas at dose rates of 1800 parts per million (ppm) for 1 h, 900 ppm for 2 h, or 450 ppm for 4 h. In all cases, the total EtO exposure was 1800 ppm.h. Immediately after exposure, and at time up to 24 h following exposure, groups of EtO-treated mice were given testicular injections of ^{3}H-thymidine. Early spermatids, a DNA-repair competent stage, were used to study the effects of the different EtO exposures.

23697 (ORNL—6353, pp 77-79) **Mechanisms for induction of chromosome aberrations in male germ cells by chemical mutagens.** Generoso, W.M.; Braden, P.W.; Cain, K.T.; Hughes, L.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors have been studying acrylamide for the purpose of investigating the relationship between the molecular binding property and the induction of dominant lethals and translocations. Results indicate that acrylamide induces dominant lethals in early spermatozoa and late spermatids, but not in other stages. In a recently completed heritable-translocation study, they found acrylamide to have a strong positive effect. Up to 40% of male progeny of acrylamide-treated male parents carried one or more translocations. The chemical is not mutagenic in Salmonella, is only marginally mutagenic in mouse bone-morrow cells, and is negative in the germ-cell unscheduled DNA synthesis test. Acrylamide appears to bind to DNA very slowly.

23698 (ORNL—6353, pp 79-80) **DNA repair studies in mouse germ cells exposed to two carcinogens and two noncarcinogens.** Sega, G.A.; Owens, J.G. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

An in vivo test was used to measure induced unscheduled DNA synthesis (UDS) in the germ cells of male mice exposed to the carcinogens benzo(a)pyrene [B(a)P] and 2-acetylaminofluorene (2AAF), and to the noncarcinogens pyrene (PYR) and 4-acetylaminofluorene (4AAF). Early spermatids, a DNA-repair competent stage, were used to test the effects of all chemicals. After chemical treatment and testicular injection of [^{3}H]dThd, sperm were recovered 16 days later from the caudal epididymides (these sperm were in early spermatid stages at the time of treatment) and assayed for the unscheduled incorporation of [^{3}H]dThd using liquid scintillation counting (LSC). Exposures of 2AAF ranged from 125 to 1600 mg/kg, 4AAF from 125 to 2000 mg/kg, PYR from 100 to 600 mg/kg, B(a)P from 100 to 400 mg/kg. Chemicals were administered both by intraperitoneal (i.p.) injection and by gavage. Methyl methanesulfonate (MMS) was used as a positive control.

23699 (ORNL—6353, pp 80-82) **Specific-locus experiments and related studies with four chemicals.** Russell, L.B.; Bangham, J.W.; Carpenter, J.W.; Carpenter, D.A.; Cummings, C.C.; Guinn, G.M.; Hunsicker, P.R.; Maddux, S.C.; Phipps, E.L.; Sega, G.A.; Stelzner, K.F.; Stenglein, F.J. Jr. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The mouse specific-locus test (SLT) is used as a standard against which the predictiveness of short-term tests for detecting the induction of heritable mutations in mammals may be assessed. An attempt is made to enlarge the SLT data base by investigating the mutagenesis of 6-mercaptopurine, urethane, acrylamide, and platinol.

23700 (ORNL—6353, pp 83-84) **Exposure of female mice to ethylene oxide within hours after mating leads to fetal malformation and death.** Generoso, W.M.; Braden, P.W.; Cain, K.T.; Hughes, L.A. Feb 1987. NTIS, PC A11/MF A01; A. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Investigations by the authors have changed the long-standing belief that abnormalities in surviving embryos can only be induced by chemicals beginning with the period of organogenesis. The effects of ethylene oxide were studied in mice fetuses of mothers that were exposed by inhalation either before they were mated or after mating. Exposure of females prior to mating resulted in increased number of resorption bodies primarily. This response is probably attributable to dominant-lethal mutations induced by ethylene oxide in ovarian oocytes. Exposure administered 1 or 6 h after mating greatly increased the numbers of midgestation and late fetal deaths. A high rate of congenital abnormalities among dead fetuses was observed. Examination of living fetuses from females that had been exposed 1 or 6 h postmating easily identified the obvious abnormalities. These defects were not found among fetuses in the 9- and 25-h groups. The stage-dependent sensitivity and the varied nature of congenital defects suggest a genetic basis for the response. It raises questions regarding the vulnerability of human zygotes when the mother is exposed to environmental chemicals.

23701 (ORNL—6353, pp 85-86) **Cytogenetic and developmental studies of embryonic abnormalities induced by.** Katoh, M.; Generoso, W.M. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors have begun a study designed to analyze the nature of these developmental anomalies, using EMS. Like EtO, EMS produced resorption moles and midgestation and late fetal deaths following exposure of early zygotic stages. The early cleavage embryos appear normal as examined under phase-contrast microscope except for a slight delay in the division of blastomeres. By the time control embryos reached early blastocyst stage, many embryos in the EMS group were abnormal. They failed to form the blastocoele, and the blastomeres were uneven in size. It is likely that these abnormal embryos are responsible for the decidual reaction that formed the resorption moles. This developmental study will be carried out also for the postimplantation embryos in order to analyze midgestation and late fetal deaths. An accompanying cytogenetic study of the developmental anomalies is also under way.

23702 (ORNL—6353, pp 86-87) **Synergistic and antagonistic interactions of two radiation-induced dominant skeletal mutations in mice.** Selby, P.B.; Raymer, G.D.; McKinely, T.W. Jr.; Niemann, S.L. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The study of the interaction mutations Ccd (Cleidocranial dysplasia) and Dsd (Dominant short digits), both of which are congenic on the C57BL/10 genetic background, was completed. Double heterozygotes were constructed to determine whether these mutations might together cause malformations that neither some can cause by itself. When acting alone, each mutation produced 14 different abnormalities, with very different degrees of penetrance. The authors earlier showed that both mutations are homozygous lethal and unlinked. Homozygotes for Dsh are short-limbed dwarfs that always lack forefeet and hindfeet, and usually also lack eyes, ears, external genetalia, and a mouth. The head is greatly reduced in size and has a long trunk. On the C57BL/10 genetic background, many of these homozygotes liver at least until 12 days p.c., and on the mixed C3H-102 genetic background, they often live until late pregnancy. Because these mutations influence many developmental pathways severely enough to cause abnormal morphology, it is likely that they influence still other developmental pathways to a lesser degree. Since one abnormality (a hole between the frontals) is found in both syndromes, it seems especially likely that Ccd and Dsh may influence some common developmental pathways and that, if both mutations are present in the same mouse, some of their combined influences might exceed thresholds for anomalies that neither mutation an produce alone.

23703 (ORNL—6353, pp 87-89) **Phenylalanine clearance rate in mice: studies on dilute-opisthotonic and other mutants.** Jacobson, K.B.; Wright, E.B.; Hunsicker, P.R. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

One of the goals in biochemical genetics is to characterize the biochemical defect that results from a mutation. It is seldom possible to predict the biochemical lesion from observation of the phenotype of a mutant. However, if there are two traits, the predictability should be improved. Accordingly, the authors have sought mutants that have a defect in melanin pigment and that have some neurological defect. Since phenylalanine is utilized for both melanin and adrenalin synthesis, they have examined a number of mouse strains and mutants that have altered pigmentation and neurological traits to measure the rate at which they clear phenylalanine from the serum. A defect in phenylalanine oxidation could be due either to the phenylalanine hydroxylase or the tetrahydrobiopterin cofactor used by this enzyme.

23704 (ORNL—6353, pp 101-102) **Studies on T(X;7)18Rl, an X-7 translocation in which non-inactivation of one translocation product is demonstrable.** Russell, L.B.; Bangham, J.W. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The authors continued studies with the X-autosome translocation T(X;7)18Rl(R18), which in several respects resembles R2, previously unique in providing evidence of non-inactivation in one of the translocation products. R18 was found in a specific-locus experiment among offspring derived from ENU-exposed spermatonia. Since T(X;A)s are unable to pass through male meiotic divisions, it is likely that R18 arose spontaneously in a postmeiotic stage. R18 resembles other T(X;A)s in the following general features: some autosomal genes are inactivated in females but not in males; females are semisterile or infertile, small, of reduced prenatal viability, and with slightly reduced ability to raise their offspring; males are totally sterile, but otherwise normal. The authors have weighed all offsprings at weaning. Paired comparisons show that R18 females weigh only 75.1% as much as their non-R female littermates, while the weight of R18 males is 101.0% that of their non-R male littermates. Although production of offspring in the R18 stock is very slow, they have added considerably to information needed for breakpoint mapping by obtaining testes weights on almost all male offspring in the stock. The testes of translocation heterozygotes are only about one-fourth normal weight and male segregants can therefore be simultaneously classified for translocation genotype and color markers. To map the Chromosome-7 breakpoint, they have carried out a 3-point cross with c/sup ch/, p, and R18.

23705 (ORNL—6353, pp 106-108) **Regulation of pteridine biosynthesis and of pteridine function.** Jacobson, K.B.; Manos, R.E.; Wright, E.B. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Two technical developments have been accomplished that will facilitate studies on pteridine biosynthesis. First, a method was developed for the isolation and stable storage of dihydroneopterin triphosphate. This compound is the substrate for the enzyme that produces 6-pyruvoyltetrahydropterin. The highly purified enzyme from E. coli GTP cyclohydrolase is used to convert GTP to dihydroneopterin triphosphate. A second technical accomplishment was the evaluation of a variety of pteridines for their affinity for C18 Sep Pak cartridges. The authors found that certain pteridines have a high affinity for C18 Sep Pak and they can be isolated from complex mixtures. Furthermore, the high affinity can be altered by causing the pterin to acquire a positive or negative charge.

23706 (ORNL—6353, pp 120-122) **Detection of protein perturbations in metabolically activated cells.** Mansfield, B.K.; Mann, R.C.; Noghrei-Nikbakht, P.A. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

Experiments were performed in an attempt to understand the genetic and biochemical mechanisms involved in a given carcinogen being more susceptible to malignant transformations in one species than in another. It is important to determine if species variance to chemical carcinogenesis is a function of the genetic regulation of the array of enzymes involved in activation and detoxification of the carcinogen. The authors have developed the capability of generating reproducible 2-DGE polypeptide spot patterns that make it possible to carry out computer image analysis and comparison of multiple images with the use of two-dimensional gel electrophoresis. This system has proven to be sensitive to kinetic changes in individual polypeptides and capable of detecting qualitative polypeptide differences between treated and control cells. They have used flow cytometry to study two subpopulations of C3H 10T1/2 cells that differ in the metabolism of benzopyrene.

23707 (ORNL—6353, pp 138-142) **Inhibition of lung tumor development by hyperoxia and by oxidants.** Witschi, H.P.; Margaretten, N.C.; Stephens, T.J.; Whitaker, M.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In the last few years, a new hypothesis was developed to explain the mechanisms of action of tumor promoters. Multiple experiments suggest that oxygen-free radicals play a crucial role in the promotion of mouse skin tumors. Experiments were performed to directly test the oxygen free radical hypothesis. The authors treated strain A mice with one dose of a carcinogen (urethan or 3-methylcholanthrene). Four days later the authors placed the animals in an atmosphere of 70% oxygen, where they remained for 4 months. They found that mice tolerated continuous exposure to 70% oxygen for 4 months, but that oxygen profoundly inhibited the development of lung tumors. The observation raised the question whether other oxidants would have a similar effect. In view of widespread concern about the biological effects of air pollutants, it was decided to examine the effect ozone on lung tumor development in mice. Mice, either strain A/J or Swiss-Webster, were exposed for 18 wks to filtered air, or to 0.4 or 0.8 ppm of ozone for 8 h daily. Tumor incidence in Swiss-Webster mice was 0-3% in groups not receiving urethan and was 61-74% in groups receiving urethan. In A/J mice, the corresponding values were 9-38% and 100%, respectively. Exposure to ozone caused a decrease in the number of tumors per lung in urethan-treated mice of both strains in a dose-dependent manner. Once the authors had made the observation that hyperoxia or ozone prevent the development of lung tumors in mice, they attempted to establish whether lung tumors in species other than the mouse would be oxygen-sensitive. The model selected was squamous cell lung tumors in rats produced by 3-methylcholanthrene (MCA).

23708 (ORNL—6353, pp 142-143) **Cell kinetics and acute lung injury.** Witschi, H.P.; Whitaker, M.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In order to estimate whether acute lung injury is followed by a stereotype pattern of cell proliferation in the lungs, mice were treated with three cytostatic drugs: cyclophosphamide, busulfan, or 1,3-Bis(2-chloroethyl)-1-nitrosourea (BCNU). The alveolar labeling index was measured following drug administration with a pulse of ^{3}H-labeled thymidine and autoradiography. In cyclophosphamide treated animals, peak alveolar cell proliferation was seen 5 days after injection of the drug. In animals treated with busulfan or BCNU, proliferation was even more delayed (occurring 2 to 3 wks after administration). In contrast, with oleic acid, the highest alveolar cell labeling was found 2 days after intravenous administration. In animals exposed to a cytostatic drug, proliferation of type II alveolar cells was never a prominent feature; whereas, in animals treated with oleic acid there was an initial burst of type II cell proliferation. It was concluded that the patterns of pulmonary repair vary between chemical designed to interfere with DNA replication as compared to agents which produce acute lung damage such as oleic acid.

23709 (ORNL—6353, pp 143-146) **Skin painting studies.** Witschi, H.P.; Smith, L.H.; Goad, M.E.; Anthony, W.B.; Gipson, L.C.; Stephens, T.J.; Whitaker, M.S. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In order to estimate eventual risks to human health as a consequence of incidental and prolonged skin contact, it is necessary to obtain some information on the potential of coal-derived liquids to elicit skin cancer. In addition, it also must be established whether prolonged dermal exposure will produce signs of toxicity not only on the skin but to internal organs. During the past 2 years, they completed a life-long skin painting study with mice designed to answer some of these questions. The following materials were tested: Raw H-coal blend, containing 5700 ppm N; H-coal blend after low hydrotreatment (2650 ppm N); H-coal blend after high hydrotreatment (0.2 ppm N); H-coal home heating oil, a devolatilized version of the high-hydrotreatment H-coal blend; and an H-coal reformed naphtha. Two petroleum-derived references samples were used: Petroleum No. 2 fuel oil and high catalytically cracked naphtha. Benzo(a)pyrene was used as reference substance. Experimental animals were male and female C3H mice.

23710 (ORNL—6353, pp 146-149) **Toxicokinetics of complex mixtures.** Smith, L.H.; Witschi, H.P.; Stephens, T.J. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

In an attempt to further define more clearly the problems involved in the toxicokinetics of complex hydrocarbon mixtures, the authors have designed experiments to determine the influence of a variety of dermally applied mixtures on the pharmacokinetics of simultaneously applied marker compounds, i.e., B(a)P, aza B(a)P, and $HgCl_2$. The basic procedure was to apply the complex mixture and radioactive marker to the skin, and at intervals determine the subsequent tissue distribution and excretion of radioactivity. Male BALB/c Bd mice were shaved on the back and sides, and 10 μl each of the test mixture and of the radiolabeled marker were applied to the animal's back. No more than 40 μCi were applied to each mouse. Nine treated mice were placed together in a metabolism cage that allowed separate collection of urine and feces. At 1, 6, and 24 h, three mice were sacrificed to obtain tissues which were assayed for radioactivity along with the urine an feces. Organs assayed were liver, kidney, thymus, spleen, testis, brain, and lung. As a first approach to analysis of the distribution data, radioactivity of the seven organs was combined and expressed as a percent of the applied dose as were excretion values. Studies with three markers have been completed - ^{3}HB(a)P, aza ^{3}HB(a)P, and $^{203}HgCl_2$.

23711 (ORNL—6353, pp 156-160) **Environmental mutagen, carcinogen, and teratogen information program.** Wassom, J.S.; Francis, M.W.; Mavournin, K.H.; Morgan, H.B.; Von Halle, E.S.; Whitfield, B.L. Feb 1987. NTIS, PC A11/MF A01. File Number DE87006021.

In Biology Division progress report for period of October 1, 1985-September 30, 1986.

The primary focus of the Environmental Mutagen, Carcinogen, and Teratogen Information Program (EMCTIP) is the establishment of information files that can be accessed readily by research personnel, health administrators, and others interest in the scientific disciplines of genetic and reproductive toxicology, carcinogenicity, and in vitro cell transformation. The files maintained by the Program are designed to be responsive to users and to provide accurate information retrieval. This characteristic, coupled with that of having available in-house copies of all cited documents, makes these files unique. The Program has received considerable recognition for efforts to establish an information service that facilitates research in the discipline covered.

23712 **Reaction mechanisms of trans-1,2-dihydroxy-anti-3,4-epoxy-1,2,3,4-tetrahydo-5-methylchrysene with DNA in aqueous solutions.** Kim, M.H.; Geacintov, N.E.; Pope, M.; Pataki, J.; Harvey, R.G. (New York Univ., NY). *Carcinogenesis;* **6**: No. 1, 121-126(1985). Contract AC02-76EV02386.

Reactions of trans-1,2-dihydroxy-anti-3,4-epoxy-1,2,3,4-tetrahydro-5-methylchrysene (anti-5-MeCDE) with DNA and the effects of ionic strength on the reaction were studied in aqueous buffer solution by aqueous buffer solution by means of absorption and fluorescence spectroscopy. The results are compared with those obtained with the widely studied metabolite model compound trans-7,8-dihydroxy-anti-9,10-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene (BaPDE). The rate constant of hydrolysis of 5-MeCDE is $k = 1.0 \times 10^{4}$/s, which is ~35 times smaller than the value of k for BaPDE under similar conditions. As in the case of BaPDE, the rate of reaction of 5-MeCDE is accelerated in the presence of DNA. This effect is attributed to the rapid formation of physical association complexes and the subsequent slower formation of carbocations at DNA binding sites, which in turn decay rapidly via hydrolysis to tetraols and to covalent adducts. The values of K and k_3 are 2800 +/- 300/M and 8.7×10^{-3}/s respectively, and are reduced to 450 +/- 100/M and 1.8×10^{-3}/s in the presence of 0.1 M NaCl. The fraction of 5-MeCDE molecules which bind covalently to DNA is, on the other hand, constant under these conditions and lies in the range of 5-8%. Similar values for the covalent binding are observed for BaPDE, even though the physical association constant K is ~10 times larger than for 5-MeCDE under similar conditions. This difference in the values of K are attributed to the larger aromatic ring system in BaPDE which allows for a higher interaction of this molecule with the bases of DNA. Finally, the tetraol derived from the hydrolysis of 5-MeCDE also binds non-covalently to DNA, but the value of K is ~3 times smaller than for the diol epoxide. 34 references, 6 figures, 1 table.

23713 **Structural effects in reactivity and adduct formation of polycyclic aromatic epoxide and diol epoxide derivatives with DNA: comparison between 1-oxiranylpyrene and benzo[a]pyrenediol expoxide.** Kim, M.H.; Geacintov, N.E.; Pope, M.; Harvey, R.G. (New York Univ., NY). *Biochemistry;* **23**: No. 23, 5433-5439(1984). Contract AC02-76EV02386.

Reaction of 1-oxiranylpyrene (1-OP) with DNA and the structures of the covalent and noncovalent complexes formed were studied in aqueous media by utilizing the techniques of absorption, fluorescence and linear dichroism spectroscopy in order to gain an understanding of possible structure-activity relationships for polycyclic aromatic hydrocarbon epoxides in tumorigenesis and carcinogenesis, and the results were compared with those obtained for the highly active benzo[a]pyrene diol epoxide (BaPDE). Like BaPDE, 1-OP undergoes acid-catalyzed hydrolysis with the pseudo-first-order rate constant $k = 4.6 \times 10^{-4}\ s^{-1}$ in the absence of DNA, which is about 10 times slower than in the case of BaPDE. In DNA solutions, this hydrolysis is catalyzed by a rapid formation of a physically bound complex of 1-OP-DNA, which subsequently undergoes either (a) hydrolysis to a diol derivative or (2) formation of a covalent adduct of 1-OP-DNA. The same value of the noncovalent binding constant ($K = 4000\ M^{-1}$) is obtained for both 1-OP and for BaPDE, which suggests that the π-electron interaction between the pyrenyl moiety and the nucleic acid bases is the dominant factor in the formation of the physical complexes. The most striking difference between the structures of these two adducts is the linear dichroism (LD): unlike the BaPDE-DNA adduct which exhibits positive LD signals, characteristic of external binding sites, 1-OP-DNA adducts exhibit negative LD with the angle of orientation of the pyrenyl chromophore with respect to the DNA helix axis theta = 65 +/- 3%, indicating conformations close to, but not identical with, those of dye-DNA intercalation complexes. 39 references, 7 figures, 2 tables.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 23095, 23557

23714 **(AD-A—176012/3/XAB) Functional assessment of high-level laser irradiation. Annual progress report, 1 August 1983-31 December 1984.** Robbins, D.O. (Ohio Wesleyan Univ., Delaware (USA)). Jan 1985. 36p. NTIS, PC A03/MF A01.

High-energy, Q-switched pulses from a laser are known to produce punctate lesions on the retina. The structural alterations often extend well beyond the primary area of exposure. This report examines the changes in visual sensitivity following single pulses of 532 nm light several orders of magnitude above the ED 50 level. Both temporary and long-term changes in spectral acuity and contrast sensitivity indicate the functional consequences of intense laser irradiation of minute areas of the central fovea.

23715 **(BPA—888) A practical handbook for the location, prevention and correction of television interference from overhead power lines.** Loftness, M.O. (Loftness (Marvin O.) (USA)). 26 Mar 1977. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87006819.

This handbook is intended for practical use in the location, prevention and correction of television interferences (TVI) from overhead transmission and distribution lines. The theoretical aspects of interference generation are introduced and practices in design, construction and correction which have proven successful in interference suppression are described in detail. The latest well-proven techniques and equipment for locating fair weather television interference are emphasized. Construction details are provided for recommended test equipment not commercially available. In the case of foul weather TVI, methods are described for improving television reception near transmission facilities. This applies to 60 Hz ac lines where the NTSC (National Television System Committee) method of television transmission is used. Many of the principles discussed apply to other power frequencies and television transmission systems used elsewhere.

23716 **(LBL—20765) Biological effects of extremely-low-frequency magnetic fields.** Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). Feb 1986. Contract AC03-76SF00098. 23p. (CONF-860210—4). NTIS, PC A02. File Number DE87006145.

From IEEE Power Engineering Society winter meeting; New York, NY, USA (2 Feb 1986).

The interaction mechanisms and biological effects of time-varying magnetic fields in the extremely-low-frequency (ELF) range are reviewed. Although several models have been proposed of both linear and nonlinear mechanisms through which ELF fields could perturb the functions of biological systems, it is concluded that the induction of Faraday currents in tissue is the only established physical interaction mechanism at the present time. The one biological effect of these fields that has been independently replicated in many laboratories is the induction of magnetophosphenes in the visual system during exposure to sinusoidal or pulsed magnetic fields with frequencies in the ELF range. Time-varying magnetic fields that induce tissue current densities in excess of approximately 10 mA/m^2 have also been observed in many laboratories to perturb the function of living systems, most notably in the case of pulsed fields with rapid rise times. These findings suggest that magnetic induction of tissue electrical currents which exceed the endogenous level can produce measurable biological effects. A summary and critical evaluation is given of several recent epidemiological reports which suggest that residential and/or occupational exposure to ELF fields may lead to an increased risk of cancer. It is concluded that these studies generally suffer from both dosimetric and methodological deficiencies, and that definitive conclusions cannot be drawn at the present time concerning the possible relationship of ELF field exposure and cancer risk. 181 refs., 4 tabs.

23717 **(LBL—22321) Interaction mechanisms, biological effects and biomedical applications of static and extremely-low-frequency magnetic fields.** Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 60p. (CONF-860451—2). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006946.

From 22. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (2 Apr 1986).

A major stimulus for research on the bioeffects of static magnetic fields has been the effort to develop technologies for energy production and storage that utilize intense magnetic fields. In addition, the rapid emergence of magnetic resonance imaging as a new clinical diagnostic procedure has provided a strong rationale for defining the possible biological effects of magnetic fields with high intensities. The numerous sources of time-varying magnetic

fields with frequencies in the extremely-low-frequency (ELF) range has also led to an increased emphasis on defining the interactions of these fields with biosystems. Of particular interest has been the potential biological effects of fields with 50 and 60 Hz frequencies. However, fields with other frequencies in the ELF range are also of interest because of their use in communication systems and in certain medical procedures. In this report the principal interaction mechanisms of static and time-varying magnetic fields are described, and a summary is provided of the current state of knowledge on the biological effects of these fields based on laboratory studies. The final section describes several useful applications of magnetic fields in medicine and biological research. 179 refs., 5 figs.

58 GEOSCIENCES

23718 **(DOE/S—0056) Geoscience research for energy security.** (USDOE Energy Research Advisory Board, Washington, DC. Solid Earth Sciences Panel). Feb 1987. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006156.

This report focuses on the nation's geoscience needs and recommends DOE activities to mitigate major problems that effect energy security. The report recommends new or redirected DOE geoscience research initiatives for oil and gas, coal, nuclear resources, structures and processes in the earth's crust, geothermal resources, oil shale, and waste disposal. In light of the current and near-term national energy requirements, federal budget constraints, and the diminished R & D efforts from the domestic energy industry, the Board recommends that DOE: assign highest geoscience research emphasis to shorter-term, energy priorities of the nation; particularly advanced oil and gas exploration and production technologies; establish in DOE an Office of Geoscience Research to develop and administer a strategic plan for geoscience research activities; establish oil and gas research centers within each of the six major oil and gas provinces of the United States to conduct and coordinate interdisciplinary problem-oriented research; increase oil and gas research funding by an initial annual increment of $50 million, primarily to support the regional research centers.

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 23467, 23468

23719 (DOE/ER/60152—1-Pt.2, pp 683-694) **Effects of fracture roughness on fluid flow through a single deformable fracture.** Tsang, Y.W.; Witherspoon, P.A. (Lawrence Berkeley Lab., CA). 1985. NTIS, PC A19/MF A01. File Number DE87005740. (CONF-850101—Pt.2). Contract AC03-76SF00098.

From International congress on hydrology of rocks of low permeability; Tucson, AZ, USA (7 Jan 1985).

The cubic law for fluid flow through a single fracture commonly employed in simulations of fluid flow through a fractured medium assumes the smooth parallel-plate idealization of each fracture. This paper summarizes results of theoretical investigations on the effects of fracture surface roughness on fluid flow through a single deformable fracture. A rough fracture may be envisioned as a collection of voids which deform as the fracture closes under stress. Mathematically, the collection of voids can be defined in terms of an aperture density distribution. The authors constructed a theory to relate the geometrical characteristics of the fracture to its mechanical properties so that an aperture density distribution for the fracture may be derived from fracture stress-strain measurements. A review of available fracture roughness profiles showed that the aperture density distributions of real fractures may take on various shapes: sharply peaked, broad and flat, skewed and peaked toward the large apertures or toward the small apertures. The different shapes give rise to qualitatively different variations of flow rate with normal stress applied to the fracture. 21 references, 10 figures.

23720 **(DOE/ID—22071) Capacity of the diversion channel below the flood-control dam on the Big Lost River at the Idaho National Engineering Laboratory, Idaho.** Bennett, C.M. (Geological Survey, Idaho Falls, ID (USA)). Oct 1986. 29p. (USGS/WRI—86-4204). NTIS, PC A03. File Number DE87006753.

Stage-discharge relations were computed for two selected cross sections of a diversion channel at the Idaho National Engineering Laboratory for discharges between 2000 and 7200 cubic feet per second. The channel diverts water from the Big Lost River into four spreading areas where the water infiltrates into the ground or evaporates. Computed water-surface profiles, based on channel conditions in the summer of 1985, indicate that the diversion channel will carry a maximum discharge of 7200 cubic feet per second from the Big Lost River into the first spreading area. Backwater from the spreading areas is not expected to decrease the carrying capacity of the diversion channel. An additional 2100 cubic feet per second will pass through two low swales west of the main channel for a combined maximum diversion capacity of 9300 cubic feet per second.

23721 (INIS-mf—10581, pp 155-157) **Interesting case of radioactive disequilibrium from Mt. Schank, South Australia.** Smith, B.W.; Prescott, J.R.; Hutton, J.T.; Murray, A.S.; Dickson, B.L. (Adelaide Univ., Australia. Dept. of Physics; Office of the Supervising Scientist for the Alligator Rivers Region, Sydney, Australia; Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia. Div. of Mineral Physics). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Mt. Schank in South Australia is a recent volcano, the age of which has been found using thermoluminescence dating. The natural uranium series, which contributes to the radiation dose, was found to be in gross disequilibrium, the detail of which have been examined using alpha and gamma spectroscopy. It is suggested that most of the U and Ra were removed at about the time of the lava flow 5ka ago and that some Th was carried in.

23722 (INIS-mf—10581, pp 231-235) **Changing face of fission track dating: recent advances.** Green, P.F.; Duddy, I.R.; Gleadow, A.J.W.; Laslett, G.M.; Hegarty, K.A.; Lovering, J.F. (Melbourne Univ., Parkville, Australia. Dept. of Geology). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Fission Track Dating has undergone something of a renaissance in recent years. What began as a rather unreliable method of geochronology has now become a rigorous and dependable means of measuring not only geological time but also paleotemperatures. Developments such as the zeta calibration technique, rigorous satistical data analysis, investigation of confined track lengths and detailed studies of annealing behaviour have all contributed to advances in the technique.

23723 **(RHO-BW-SA—565-P) Form and composition of secondary mineralization in fractures in Columbia River basalts.** McKinley, J.P.; Rawson, S.A.; Horton, D.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1986. Contract AC06-77RL01030. 11p. (CONF-860829—40). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007395.

From Annual joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society; Albuquerque, NM, USA (10 Aug 1986).

Examination of basalt alteration rinds suggests that pyroxene is altered, along with mesostasis, from the inception of hydrothermal alteration along cooling fractures in Columbia River basalts. The only phyllosilicate secondary mineral in fractures is trioctahedral smectite of Fe-saponite composition, throughout the examined thickness of the basalt column. This smectite is compositionally distinct from the minor amounts of mesostasis smectite found in otherwise unaltered outcrop samples of basalt.

23724 **(RHO-BW-SA—586-P) A comparative study of sensitivity coefficient calculation methods in groundwater flow.** Li, L.S..; Sun, N.Z.; Yeh, W.W.G.; Lu, A.H. (California Univ., Los Angeles (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jan 1987. Contract AC06-77RL01030. 37p. (CONF-860681—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007170.

From 6. international conference on finite elements in water; Lisbon, Portugal (1 Jun 1986).

Sensitivity coefficients can ba calculated by (1) the influence coefficient method, (2) the sensitivity equation method, or (3) the variational method. These three methods are summarized for both steady and unsteady state flows in a two-dimensional, inhomogeneous, confined aquifer. All algorithms are based on the finite element method. A comparison of the accuracies of the three calculation methods is made by means of an example for which the sensitivity coefficients can be obtained via analytical solutions. It is shown that the results from the three methods can be similar to those of the analytical solutions if the factors that affect the sensitivity coefficient calculation are appropriately treated. It is also shown that the sensitivity equation and variational methods are superior to the influence coefficient method, in many instances, because these two methods avoid the difficulty in selection of the perturbation vector, and that the sensitivity equation and variational methods have identical accuracies if the same grid size and time step are used.

23725 **(RHO-BW-ST—74-P) Comparison of calculated and observed hydrostatic pressure measurements at borehole DC-8.** Spane, F.A. Jr.; Thorne, P.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1986. Contract AC06-77RL01030. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007397.

Static water-level and fluid-pressure measurements are commonly converted in hydrologic studies to formation pressure and hydraulic head, which are used to determine groundwater flow characteristics of aquifer systems. For hydrologic studies that use hydraulic head and formation pressure data obtained from surface-based and downhole instruments, the relationship between water-level and downhole-pressure measurements must be established. This report presents the results of a field evaluation of 30 quartz pressure probes, which were used in the reference repository location baseline monitoring program. The pressure probes were field tested at a depth of 2,700.23 ft within borehole DC-8 between December 1984 and April 1985. Water-level measurements corrected for instrumental and noninstrumental errors were used in the HEADCO program to calculate the hydrostatic pressure at the fixed probe depth setting. HEADCO-calculated pressure values were then compared to the fluid-column pressure measured with each probe. Results of the field evaluation at the borehole DC-8 test facility indicate that recently calibrated pressure probes give consistent and comparable pressure measurements. In all cases, the difference between measured and calculated pressure values was less than the stated manufacturer accuracy range of +-1.2 lbf/in^2. For the majority of the probes evaluated (i.e., 77%), the difference between observed and calculated pressures was 0.3 lbf/in^2 or less. The close comparison of calculated and measured pressures also indicates that accurate downhole pressures can be calculated using water-level measurements and the HEADCO program, provided that systematic errors, due to borehole deviation, and thermal expansion and elastic deformation have been accounted for in the water-level measurements.

23726 **(USGS/MAP/MF—1897) Logs of trenches across the Beatty scarp, Nye County, Nevada.** Swadley, W.C.; Huckins, H.E.; Taylor, E.M. (Geological Survey, Reston, VA (USA); Fenix and Scisson, Inc., Tulsa, OK (USA)). 1986. 25p. U.S.G.S., Box 25286 Federal Center, Denver, CO 80225. File Number TI87006793.

The trenches described in this report are part of a study to evaluate the age of possible Quaternary offset along a prominent scarp that is commonly referred to as the Beatty fault. The Beatty scarp is along the west side of Bare Mountain, 2 km south of Beatty, Nye County, Nevada. The west-facing scarp trends generally north-south and extends for approximately 10 km, nearly parallel to US Highway 95 and to the main channel of the nearby Amargosa River. The scarp is formed chiefly in coarse alluvial gravels of early to middle Pleistocene age; minor segments of the scarp are in Paleozoic sedimentary rocks. The scarp is discontinuous; for about 55% of its length, it has been destroyed by erosion by intermittent, crosscutting streams, or it is buried by younger deposits of crosscutting streams. Data suggest that the Beatty scarp at that location resulted from lateral erosion by the Amargosa River and that fluvial deposits exposed in the trench at the base of the scarp are contemporaneous with tht erosion. Dating of these deposits should provide a minimum age for the scarp. Trench BF-2 exposed no conclusive evidence of faulting along that part of the scarp. If faulting occurred, it preceded unit Q1c deposition (early Holocene?).

23727 **Role of pore water circulation during the deformation of foreland fold and thrust belts.** Engelder, T. (Columbia Univ., Palisades, NY). *Journal of Geophysical Research;* **89**: No. B6, 4319-4325(10 Jun 1984). Contract AC02-76ER04054.

Volume-loss strain accompanying pressure solution of calcite occurred within both the Umbria-Marches Apennines of Italy and the Appalachian Mountains of western New York. Data from strain markers show that volume-loss strain was greater within the shallow portions of the Apennines than within the Appalachians. Within the deeper portions of both fold and thrust belts, strain was nearly volume-constant. Calcite solubility data suggest that downward circulation of meteoric water is necessary for the 35% volume-loss strain of the limestones within the Apennines. Strain at a depth of about 1 km was volume-constant and is interpretated as indicative of restricted pore fluid circulation. In the Appalachians, calcite comprises less than 1% of the clastic rocks, and a 10% volume-loss of this calcite may occur during circulation of connate or dehydration water derived from dewatering of the shales but in an environment that restricts the circulation of meteoric water. Here, the volume of calcite removed (0.1% of the total rock) is so small that circulation of meteoric water is not necessary for strain by pressure solution. 29 references, 6 figures.

23728 **Spheroids at the Cretaceous-Tertiary boundary are altered impact droplets of basaltic composition.** Montanari, A.; Hay, R.L.; Alvarez, W.; Asaro, F.; Michel, H.V.; Alvarez, L.W.; Smit, J. (Univ. of California, Berkeley). *Geology;* **11**: 668-671(Nov 1983).

Sand-size spheroids of K-feldspar in the Cretaceous-Tertiary (C-T) boundary clay at Caravaca, southern Spain, were interpreted by Smit and Klaver as having solidified from a melt resulting from the impact of a large extraterrestrial body. Sand-size spheroids of K-feldspar, glauconite, and magnetite-quartz have been found in the C-T boundary clay in northern Italy, and spheroids of K-feldspar and pyrite were found in the boundary clay at Deep Sea Drilling Project Site 465A, in the central Pacific. These spheroids have textures similar to those of rapidly crystallized feldspar and mafic silicates. They are interpreted as diagenetically altered microcrystalline spherules of basaltic composition produced by the impact of a large asteroid in an ocean basin at the end of the Cretaceous. They are analogous to the glassy microtektites produced by impacts on more siliceous target rocks. 21 references, 4 figures.

23729 **Experimental support for a predictive osmotic model of clay membranes.** Fritz, S.J.; Marine, I.W. (Texas A & M Univ., College Station). *Geochimica et Cosmochimica Acta;* **47**: 1515-1522(1983).

Osmosis has been cited as a mechanism for explaining anomalously high fluid pressures in the subsurface. Clays and shales act as membranes, and osmotic flux across these units may result in pressures sufficiently high to explain these anomalies. The theoretical osmotic pressures as calculated solely from solution properties can be quite large; however, it is not yet resolved whether these geologic membranes are sufficiently ideal to generate such pressures. Osmotic efficiencies of a Na-bentonite membrane were measured by a series of hyperfiltration experiments using various molarities of NaCl at two different porosities. The highest osmotic efficiency (0.8912) occurred at the lower porosity and the lowest NaCl input solution. The lowest measured osmotic efficiency (0.0423) occurred at the high porosity and the highest NaCl input concentra-

tion. The osmotic efficiencies obtained from the hyperfiltration experiments correlate very favorably with the Fritz-Marine Membrane Model. This model predicts that the maximum osmotically-induced hydraulic pressures in the subsurface should occur across shales having low porosities and high cation exchange capacities in which the unit separates solutions of brackish waters. 25 references, 2 figures, 2 tables.

5802 Geophysics

REFER ALSO TO CITATION(S) 22266, 22269

23730 (SAND—87-0269) Finite element simulation of penetration into geological targets. Chen, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 37p. NTIS MF A01; 2; GPO Dep. File Number DE87007351.

The finite element method has been applied to study the projectile penetration process into geological targets. To illustrate the solution procedure, two example problems involving conical nose steel penetrators into sea ice and antelope tuff are presented. Details of the numerical treatment using the computer code PRONTO 2D are given. Good agreements between numerical and experimental results are observed. Although the examples are limited to normal impact problems in which the axis of the penetrator is perpendicular to the target surface and where no angle of attack for the penetrator is allowed, some thoughts regarding ways to deal with non-normal three-dimensional penetration problems are discussed. 9 refs., 20 figs.

23731 Overview and summary of results for the project: Seismic hazard characterization for the eastern United States. Savy, J.B.; Bernreuter, D.L.; Mensing, R.W. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA). pp 93-104 of Proceedings of the third U.S. national conference on earthquake engineering. Volume 1. El Cerrito, CA; Earthquake Engineering Research Institute (1986). (CONF-860816—).

From 3. U.S. national conference on earthquake engineering; Charleston, SC, USA (24 Aug 1986).

The basic characteristic of the methodology is the use of experts' opinions to supplement the sparse and often low quality seismicity and ground motion data available. The methodology also recognizes the uncertainties associated with a hazard analysis. A simulation technique is used to develop a probability distribution of the hazard. It describes the uncertainty in the hazard due to uncertainties in the source zonation maps, the ground motion models, the earthquake recurrence modeling, and the maximum magnitude possible in each source zone. The uncertainty is presented in terms of envelopes of percentile curves for the peak ground acceleration and for 5% damping spectral values.

23732 A methodology to correct for the effect of the local site's characteristics in seismic hazard analyses. Bernreuter, D.L.; Chen, J.C.; Savy, J.B. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA). pp 245-256 of Proceedings of the third US national conference on earthquake engineering. Volume 1. El Cerrito, CA; Earthquake Engineering Research Institute (1986). (CONF-860816—).

From 3. U.S. national conference on earthquake engineering; Charleston, SC, USA (24 Aug 1986).

This paper describes a probabilistic approach developed as part of an overall seismic characterization methodology to include multiple ways to account for the influence of the site's characteristics on the estimated seismic hazard at a site and how the uncertainty in the correction for the site's characteristics impacts the uncertainty in the estimate of the seismic hazard. The method developed relies on analysis and input from a panel of experts.

23733 Volcanic and stratospheric dust-like particles produced by experimental water-melt interactions. Wohletz, K.H.; McQueen, R.G. (Los Alamos National Lab., NM). *Geology;* **12**: No. 10, 591-594(Oct 1984).

Commercially available Thermit (Al + Fe_3O_4) was ignited, forming a molten mixture of Al_2O_3 + Fe. The subsequent mixing of this melt with water in steel containers produced explosive interactions that were used to model hydrovolcanic activity. Debris collected from the experiments consisted of quenched Thermit particles ranging in size from < 1 μm to centimeters. Scanning electron microscopy of the debris showed spheroidal, irregular aggregates and blocky particle shapes that are very similar to hydrovolcanic ash, as well as some types of stratospheric dust and industrial fly ash. 27 references, 3 figures, 1 table.

23734 Social factors affecting the response of groups to earthquake prediction: Implications for public policy. Mileti, D.S.; Sorensen, J.H.; Hutton, J.R. (Dept. of Sociology Colorado State Univ., Ft. Collins, CO). pp 649-658 of Earthquake prediction. Tokyo, Japan; Terra Scientific Publishing Co. (1984). (CONF-7904221—).

From International symposium on earthquake prediction; Paris, France (2 Apr 1979).

This paper is based on discussions held over a two-year period with a variety of groups in the State of California. USA Data concerning likely actions in response to a plausible earthquake prediction scenario and to actual quasi-prediction events were obtained. Reasons for the possible actions were also discussed with study respondents. On these bases, this paper identifies six key factors related to why different types of response (which can be categorized as reduction, reallocation and relocation) are likely after a prediction and warning. It seems clear that these six factors will play a key role in determining what will be done and not done to reduce hazard vulnerability and increase emergency preparedness after a prediction-warning. The factors are image of damage, exposure to risk (insurance), exposure to risk (other factors), access to information, commitment to the target area, and resources. These six factors suggest ways in which prediction-warning group response can be managed through policies designed to induce constructive responses and minimize undesirable responses.

23735 Institutional management of risk information following earthquake predictions. Sorensen, J.H.; Hutton, J.R.; Mileti, D.S. (Oak Ridge National Lab., Energy Div., Oak Ridge, TN). pp 913-924 of Earthquake prediction. Tokyo, Japan; Terra Scientific Publishing Co. (1984). (CONF-7904221—).

From International symposium on earthquake prediction; Paris, France (2 Apr 1979).

This paper describes the risk assessment process that will follow a prediction. It is likely that individuals and corporate groups will either consciously or unwittingly identify, measure and evaluate the new set of risk circumstances. In an attempt to better define and comprehend this process, four questions are addressed. First, what types of risk information will be disseminated? Second, how will risk information shape images of loss and images of uncertainty? Third, will individuals or groups have differential levels and types of risk information? Fourth, how can the capability for assessing the risk by individuals and private groups be enhanced by governmental efforts? In addressing these questions the paper points out how government institutions can help manage risk assessment activities in a manner which reduces inequities and minimizes adverse prediction impacts. In addition, the management of risk information can aid in guiding public responses to be commensurate with the prediction characteristics and scientific estimates of the earthquake risk.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 22266, 22299, 22937

23736 (DOE/NBM—7004372) Annual review of US progress in rock mechanics: Rock dynamics. (National Committee for Rock Mechanics, Washington, DC (USA). Panel on Science and Engineering of Rock Mechanics). 1986. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004372.

Topics relating to transient, high speed, and seismic processes in rock masses are covered. The topics covered include rock excavation by mechanical cutters, boring machines, water jets, and drilling. Rock blasting is discussed with special attention paid to

comminution, fragmentation, reservoir stimulation, ground vibration, and containment of underground explosions. Cratering is also covered. Rock dynamics is discussed with areas of interest including friction studies, earthquake and blast studies, as well as dynamic modeling. Seismic methods are applied to test-bam treaty verification, borehole fracture detection, hydrofracture orientation, and acoustic emission testing. (JDH)

23737 **(DOE/NBM—7007652) A study of ultrasonic surface and bulk waves in saturated porous solids: Technical report No. 11.** Mayes, M. (Lawrence Livermore National Lab., CA (USA); Ohio State Univ., Columbus (USA). Dept. of Welding Engineering). Apr 1986. Contract W-7405-ENG-48. 76p. NTIS MF A01; 2; GPO Dep. File Number DE87007652.

The acoustics of fluid-saturated porous solids were studied. These structures are characterized by the fluid pores and the solid matrix as being each continuous. The structure is typical of many sedimentary rocks and synthetic filtration materials. The thesis contains experimental measurements of bulk waves in "Biot solids," especially the slow wave. Plona's measurements are repeated and slow wave properties and detection difficulties are discussed. A "wedge" technique developed in our laboratory to enhance slow wave detection is also presented. Experimental results of surface wave velocity measurements are presented, using the periodic surface technique, as are experiments performed on various rock samples in an attempt to measure bulk and surface waves in natural materials.

23738 **(SAND—84-2621) Nevada Nuclear Waste Storage Investigations Project: G-Tunnel small-diameter heater experiments: Final report.** Zimmerman, R.M.; Blanford, M.L.; Holland, J.F.; Schuch, R.L.; Barrett, W.H. (Sandia National Labs., Albuquerque, NM (USA). Nevada Nuclear Waste Storage Investigations Projects Dept.). Dec 1986. Contract AC04-76DP00789. 235p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87007361.

Designers and analysts of radioactive waste repositories must be able to predict thermal and hydrothermal behavior of tuffs. Therefore, Sandia National Laboratories elected to conduct three experiments in both welded and nonwelded tuffs, using a single small-diameter (10.2-cm) heater for all three experiments. For two experiments, the heater was oriented vertically in fractured welded tuff and in unfractured nonwelded tuff; horizontal heater orientation was used in fractured welded tuff. The major focus of the experiments was on evaluation of numerical model applications, emphasizing thermal properties; the secondary focus was on hydrothermal measurements and evaluations.

23739 **Nd, O and Sr isotopic constraints on the origin of Precambrian rocks, southern Black Hills, South Dakota.** Walker, R.J.; Hanson, G.N.; Papike, J.J.; O'Neil, J.R. (State Univ. of New York, Stony Brook). *Geochimica et Cosmochimica Acta;* **50**: No. 12, 2833-2846(Dec 1986). Contract AC02-79ER10412;AS03-82ER12040;FG01-84ER13259.

The Nd, O and Sr isotopic characteristics of Precambrian metasedimentary, metavolcanic and granitic rocks from the Black Hills of South Dakota are examined. Two late-Archean granites (2.5-2.6 Ga) have T/sub DM/ ages of 3.05 and 3.30 Ga, suggesting that at least one of the granites was derived through the melting of significantly older crust. Early-Proterozoic metasedimentary rocks have T/sub DM/ ages that range from 2.32 to 2.45 Ga. These model ages, in conjunction with probable stratigraphic ages ranging from 1.9 to 2.2 Ga, indicate that mantle-derived material was added to the continental crust of this region during the early-Proterozoic. Previous studies of the Harney Peak Granite complex have reported U-Pb and Rb-Sr ages of about 1.71 Ga, and most granite samples examined in this study have Sr isotopic compositions consistent with that age. Two granite samples taken from the same sill, however, give two-point Rb-Sr and Sm-Nd ages of 2.08 +/- 0.08 and 2.20 +/- 0.20 Ga, respectively. In addition, whole-rock and apatite samples of the spatially associated Tin Mountain pegmatite give a Sm-Nd isochron age of 2000 +/- 100 Ma.

5804 Geochemistry

REFER ALSO TO CITATION(S) 22181, 22395, 23733, 23739

23740 **(IC—86/309) Anomalous short period geomagnetic variations at two stations in Sri Lanka.** Kunaratnam, K. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701561.

An analysis of the rates of change in the geomagnetic field components in the period range 20-600 sec recorded at Kondavil and Hikkaduwa, two stations in the equatorial electrojet belt near the northern and south western coasts respectively of Sri Lanka, shows anomalous variations. The results confirm induced current concentration in the Palk Strait and deflection of induced currents around the southerncoast of Sri Lanka postulated by earlier workers from observations of SSC and Bay events at Indian stations and from analogue and numerical model studies. At Kondavil, which is situated close to the geomagnetic equator, no appreciable difference in the night-time and day-time values of $\Delta Z/\Delta H$ and $\Delta D/\Delta H$ ratios was noticed while at Hikkaduwa, a station situated under the edge of the equatorial electrojet belt, a day-time enhancement of $\Delta Z/\Delta H$ ratios was found at all periods in the observed range. An enhancement of the H component at Colombo over that at Hikkaduwa was also found at short periods, the enhancement being greater at daytime. The day-time enhancement in the $\Delta Z/\Delta H$ ratios at Hikkaduwa and in the ratio of the H components at Colombo and Hikkaduwa could be due to the effect of the equatorial electrojet on the short period variations. 11 refs, 8 figs.

5805 Oceanography

REFER ALSO TO CITATION(S) 22313

23741 **(DOE/ER/60450—1) Coordination: Southeast continental shelf studies: A progress report.** Menzel, D.W. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 15 Jan 1987. Contract FG09-86ER60450. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006731.

Two major experiments, GABEX and SPREX, were conducted in past years: (1) to define processes controlling and associated with upwelling at the shelf break (GABEX); (2) to describe exchanges of shelf with offshore waters during the spring metorological regime (SPREX). Field work associated with the SPREX experiment was concluded in 1985. A major effort was expended during 86-87 to reduce and synthesize the data obtained in 1984 and 1985. Considerable effort was expended during the current fiscal year to redesign and modify some aspects of previously submitted "5 year plans." These modifications are sensitive on the results of recent research involving: (1) the development of a model to explain nearshore circulation and those resulting from (2) analyses of satellite imagery; and (3) tests designed to determine if tritium can be used as a unique tracer of fresh water discharged from the Savannah River.

23742 **(DOE/MC/20037—2265) Statistical description of the summertime ice edge in the Chukchi Sea: Final report, Task 2.** Stringer, W.J.; Groves, J.E. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Jan 1987. Contract AC21-83MC20037. 217p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87001056.

Ice edge data has been analyzed for ice recursion analysis in the Chukchi Sea for a twelve year period. Conclusions drawn include: (1) numerous parameter comparisons describing the great variability of ice extent found in the Chukchi Sea; (2) that for a period of 80 to 100 days beginning with August and continuing through October, ice-free water will exist in the Chukchi Sea south of 70°N and 175°W. Within these boundaries ice will return (recur) once after it has retreated in the spring, or it will retreat once after it has returned in the fall, less than 50% of the time; (3) ice in the western Chukchi Sea (along the Siberian coast) may provide multi-year ice to the Bering Sea through Bering Strait starting in late fall; (4) melt-back bays (defined by Paquette and Bourke, 1981) created by warm Bering Sea waters channeled by Chukchi Sea bathymetry

are persistent and significant features of the Chukchi Sea ice edge. 11 refs., 212 figs., 3 tabs.

64 PHYSICS I

23743 **(INIS-SU—401) Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1985. 73p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

Individual papers in this collection are abstracted separately.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 23946, 24343

23744 **(AD-A—175931/5/XAB) Distribution of flares on the sun: super-active regions and active zones of 1980-1985.** Bai, T. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). May 1986. 39p. (CSSA-ASTRO—86-31). NTIS, PC A03/MF A01.

Coordinates of energetic solar flares observed with the Hard X-Ray Burst Spectrometer during the period have shown important discoveries resulting from this analysis are as follows: (1) A small number (28) of superactive regions produced the majority of the major flares during this period. These super-active regions are large, complex active regions containing large sunspots. (2) There exist active zones, in which the flare occurrence rate is much higher. Two active zones are in the northern hemisphere, and two in the southern hemisphere. The longitudinal separation of the two active zones in the same hemisphere is about 180°, but the active zones of the southern hemisphere are misaligned from those of the northern hemisphere by about 80°. The rotation period of the active zones is 26.75 days. Active zones last several years or longer. (3) There is a hint of active center rotating at a period of 23.7 days. It is possible that active centers in deep layer rotate with such a period.

23745 (EUR—9708-Vol.2, pp 997-1017) **Solar physics. Progress in solar hydromagnetics.** Kuperus, M. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The present state of the theory of the magnetic solar cycle is reviewed and recent developments of the theory of coronal heating in terms of magnetic structures that are electrodynamically coupled to the photospheric velocity spectrum are presented. Explosive energy release in solar flares is discussed on the basis of a chain of plasma instabilities. The review concentrates on the magnetohydrodynamic aspects of the above mentioned topics and only briefly touches the microscopic aspect when necessary.

23746 (EUR—9708-Vol.2, pp 1019-1038) **Collisionless shock waves in space.** Scholer, M. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Various types of collisionless shock waves occurring in the heliosphere are interplanetary travelling shocks, shock pairs bounding corotating interaction regions, planetary bow shocks, and the heliospheric terminating shock. The earth's bow shock is the most detailed studied collisionless shock. Recent spacecraft observations at the bow shock pertaining to the structure of collisionless shocks are reviewed. In particular the dual ISEE 1 and 2 spacecraft mission allowed for the first time an exact determination of the different length scales in the shock transition region. Also determination of wave rest frame frequencies and polarisations (and thus of the wave modes) was only possible by using data from two closely spaced satellites. The viscosity at the quasi-perpendicular shock is provided by the reflected and gyrating ions. The thermalisation of the electrons is probably due to instabilities driven by the free energy in a field-aligned electron beam. This electron beam is due to the macroscopic electric field along the macroscopic magnetic field and is directed into the downstream medium.

23747 (EUR—9708-Vol.2, pp 1039-1042) **Slide-away regime in space and laboratory plasmas.** Coppi, B. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

23748 (EUR—9708-Vol.2, pp 1043-1066) **Plasma instabilities in the magnetosphere of pulsars.** Lominadze, J.G.; Melikidze, G.I.; Pataraya, A.D. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

This paper discusses some new results in the theory of the magnetosphere of pulsars and relativistic electron-positron plasmas. Certain plasma processes which may be used to interpret emission from pulsars are explained. The formation of an envelope soliton which has a non-zero charge density is also considered. The power and spectral density of the soliton which is moving along the curved magnetic field lines are calculated.

23749 (EUR—9708-Vol.2, pp 1067-1077) **Cosmic ray acceleration by collisionless shocks.** Axford, W.I. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Current ideas concerning the nature and origin of energetic particles (cosmic rays) in the galaxy are briefly reviewed. Many of the problems that have arisen are essentially plasma physical, involving the scattering of the particles by hydromagnetic waves in the background plasma, the damping of these waves and the injection of low energy plasma particles into the acceleration process. Non-linear effects are especially important, notably the dynamical effects of cosmic ray and wave pressure gradients on the bulk plasma flow, non-linear wave damping and plasma heating.

23750 (EUR—9708-Vol.2, pp 1077-1084) **Theory of galactic disks and its relevance to the solar wind magnetic configuration.** Bertin, G.; Coppi, B. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Large scale features of galactic disks, particularly spiral structure, have been successfully studied in terms of global galactic plasma modes that are excited from an axisymmetric disk configuration. In analogy with the case of gravitational plasmas, we consider the modes of oscillation for axisymmetric current disks. We suggest

that the magnetic sectors in the solar wind be explained as the result of large scale bending waves of the current disk that characterizes the solar wind magnetic configuration.

23751 **(IC—86/47) Global solar radiation in Trieste, Italy.** Anane-Fenin, K. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701403.

Global irradiation data recorded at Trieste (CNR - Istituto Talassografico di Trieste) during 11-year period are grouped into "summer" and "winter" periods and are compared with values generated from seven different models and empirical correlations proposed by earlier investigations. Climatological parameters like sunshine duration, relative humidity, cloud cover and maximum air temperature are the models input. The calculated values obtained from correlations according to Angstrom and Black give better agreement with measured data in summer. Agreements are within +-3% and +-4%. In winter a quadratic equation is in better agreement with measured values. Agreement is within +7%. 14 refs, 7 figs, 4 tabs.

23752 **(IC—86/69) On the stochastic approach to inflation and the initial conditions in the universe.** Pollock, M.D. (International Centre for Theoretical Physics, Trieste (Italy)). May 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701406.

By applying stochastic methods to a theory in which a potential V(PHI) causes a period of quasi-expansion of the universe, Starobinsky has derived an expression for the probability distribution P(V) appropriate to chaotic inflation in the classical approximation. We obtain the corresponding expression for a broken-symmetry theory of gravity. For the Coleman-Weinberg potential, it appears most probable that the initial value of PHI is PHI/sub i/ <<PHI/sub O/, in which case inflation occurs naturally, because V(PHI/sub i/)>O. 43 refs.

23753 **(IC—86/74) Eternal chaotic inflation.** Linde, A.D. (International Centre for Theoretical Physics, Trieste (Italy)). May 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701407.

It is shown that the universe evolution in the chaotic inflation scenario has no end and may have no beginning. According to this scenario, the universe consists of exponentially large number of different mini-universes inside which all possible metastable vacuum states and all possible types of compactification are realized. 17 refs.

23754 **(IC—86/75) Eternally existing self-reproducing inflationary universe.** Linde, A.D. (International Centre for Theoretical Physics, Trieste (Italy)). May 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701408.

It is shown that the large-scale quantum fluctuations of the scalar field phi generated in the chaotic inflation scenario lead to an infinite process of self-reproduction of inflationary mini-universes. A model of eternally existing chaotic inflationary universe is suggested. It is pointed out that whereas the universe locally is very homogeneous as a result of inflation, which occurs at the classical level, the global structure of the universe is determined by quantum effects and is highly non-trivial. The universe consists of exponentially large number of different mini-universes, inside which all possible (metastable) vacuum states and all possible types of compactification are realized. The picture differs crucially from the standard picture of a one-domain universe in a "true" vacuum state. Our results may serve as a justification of the anthropic principle in the inflationary cosmology. These results may have important implications for the elementary particle theory as well. Namely, since all possible types of mini-universes, in which inflation may occur, should exist in our universe, there is no need to insist (as it is usually done) that in realistic theories the vacuum state of our type should be the only possible one or the best one. 43 refs, 3 figs.

23755 **(IC—86/148) On the thermal properties of neutron matter with spin up excess.** Ramadan, S. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701405.

The schematic model of pure hard core neutron matter proposed by Dabrowski et al. is generalized to finite temperature, where the attractive part of nuclear forces is treated as a perturbation. We calculate the potential energy, the energy per neutron, the volume and symmetry pressure, the magnetic susceptibility, the effective mass and the velocity of sound as a function of temperature. Our results are compared with previous calculations. 28 refs, 8 figs.

23756 **(IC—86/181) History of the universe in a superstring model.** Maeda, K. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701530.

A superstring theory, which is most promising candidate for a unified theory, predicts a higher-dimensional 'space-time'. Its application to cosmology, especially reconsideration of the early history of the universe, is definitely important and interesting. Here, we discuss some scenario of the universe in a superstring model. Main problems in higher-dimensional unified theories, from the cosmological point of view, are: (I) Can the 4-dim Einstein gravity be obtained, rather than the Jordan-Brans-Dicke theory? (II) Can the 4-dim Friedmann universe (F/sup 4/) be realized naturally in the higher-dimensional space-time? (III) Does inflation really occur? The answers for (I) and (II) are 'yes' in a superstring model, as we will see soon. (III) is still an open question, although it seems to be difficult. Taking into account a quantum tunnelling effect of the anti-symmetric tensor field H/sub $\mu\nu\rho$/, we also show that a hierarchical bubble structure might be formed due to a series of phase transitions. 14 refs, 3 figs.

23757 **(IC—86/291) Possible inflationary solution to the short distance gravity model.** Akdeniz, K.G.; Hacinliyan, A.; Kalayci, J. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701559.

We find a solution involving a time dependent cosmological constant to the short distance gravity model which may be interpreted as inflationary. 7 refs.

23758 (INIS-mf—10589, pp 106-107) **Monte Carlo calculation of cosmogenic nuclide production.** Emrich, P.; Povinec, P.; Tokar, S. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23759 (INIS-mf—10589, pp 108-109) **Cosmogenic radiocarbon and short-term variations of galactic cosmic rays.** Jurina, V.; Povinec, P.; Burchuladze, A.A.; Pagava, S.V. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Tbilisskij Gosudarstvennyj Univ., USSR). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23760 (INIS-mf—10589, pp 125-126) **Feasibility of calculating the cosmic ray exposure rate at the Earth's surface.** Kazimir, D. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23761 (INIS-SU—378, pp 61-65) **On nature of high energy muon narrow groups.** Vavilov, Yu.N.; Dedenko, L.G. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780101.

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In Experimental and theoretical physics. Collection.

By the Monte Carlo method a series of characteristics of muon narraw gpoups arising due to nuclear cascade fluctuations is

calculated. The Coulomb muon scattering account in the ground deforms the groups into wider ones. The radius of the circle inside which the group finds grows from 0.5 to1-1.5 m. The following conclusion is drawn: either the energy muon spectrum in registered in the course of the experiment multiparticle narrow groups is higher energy than the spectrum calculated in accepted assumptions on specific features of strong interactions and the mechanism of generation of high-energy muons in nuclear cascade or the muon beams observed at the Calar Gold Fields facility are bound with interactions and decays of a new heavy strongly penetrating particle.

23762 **(KFKI—1986-34/C) Comet Halley: nucleus and jets. Results of the VEGA mission.** Sagdeev, R.Z.; Avanesov, G.A.; Barinov, I.V. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701404.

The VEGA-1 and VEGA-2 spacecrafts made their closest approach to Comet Halley on 6 and 9 March, respectively. In this paper results of the onboard imaging experiment are discussed. The nucleus of the comet was clearly identifyable as an irregularly shaped object with overall dimensions of (16 +- 1)x(8 +- 1)x(8 +- 1) km. The nucleus rotates around its axis which is nearly perpendicular to the orbital plane, with a period of 53 +- 2 hours. Its albedo is only 0.04 +- 002. Most of the jet features observed during the second fly-by were spatially reconstructed. These sources form a quasi-linear structure on the surface. The dust above the surface is shown to be optically thin except certain specific dust jets. Brightness features on the surface are clearly seen. Correlating the data with other measurements it is concluded that the dirty snow-ball model probably has to be revised. 15 refs.; 10 figs.

23763 (N—87-15043, pp vp) **Far-infrared investigation of the Taurus star-forming region using the IRAS database.** Hughes, J.D. Oct 1986. NTIS, PC A10/MF A01. (NASA-TM—88342; A—86393; NAS—1.15:88342; CONF-8607112—Absts.).

From Interstellar processes conference; Jackson, WY, USA (3 Jul 1986).

The Taurus-Auriga complex was selected as the first molecular cloud to be investigated in this study. The Taurus clouds were defined as lying between 04h and 05h in R.A. and +16 to +31 degrees in Dec., then the IRAS point-source catalogue was searched for sources with good or moderate quality fluxes in all three of the shortest IRAS bands. The sources selected were then classified into subgroups according to their IRAS colors. Taurus is generally believed to be an area of low-mass star formation, having no luminous O-B associations within or near to the cloud complex. Once field stars, galaxies and planetary nebulae had been removed from the sample only the molecular cloud cores, T Tauri stars and a few emission-line A and B stars remained. The great majority of these objects are pre-main sequence in nature and, as stated by Chester (1985), main sequence stars without excess far-infrared emission would only be seen in Taurus if their spectral types were earlier than about A5 and then not 25 microns. By choosing our sample in this way we are naturally selecting the hotter and thus more evolved sources. To counteract this, the molecular cloud core-criterion was applied to soruces with good or moderate quality flux at 25, 60 and 100 microns, increasing the core sample by about one third. The candidate protostar B335 is only detected by IRAS at 60 and 100 microns while Taurus is heavily contaminated by cirrus at 100 microns. This means that detection at 25 microns is also required with those at 60 and 100 microns to avoid confusing a ridge of cirrus with a genuine protostar. The far-infrared luminosity function of these sources is then calculated and converted to the visual band by a standard method to compare with the field star luminosity function of Miller and Scalo.

23764 **(PB—87-137766/XAB) Solar-Geophysical Data Number 507, November 1986. Part 1 (prompt reports). Data for October, September 1986, and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Nov 1986. 123p. (SGD—507-PT-1). NTIS, PC A06/MF A01.

Contents include: Detailed index for 1986; Data for October 1986--(IUWDS alert periods (Advanced and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for September 1986--(Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data--(Solar radio emission, Solar active regions January-August 1986, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Calcium plage data March-April 1986).

23765 **(PB—87-137774/XAB) Solar-geophysical data number 507, November 1986. Part 2 (comprehensive reports). Data for May 1986, and miscellanea.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Nov 1986. 36p. (SGD—507-PT-2). NTIS, PC A03/MF A01.

Contents include: Detailed index for 1986; Data for May 1986--(Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejection from the sun, Active prominences and filaments); Miscellaneous data--(International geophysical calendar 1987).

23766 **(PB—87-138095/XAB) White light solar corona: an atlas of 1985 K- coronameter synoptic charts, December 1984-December 1985. Technical note.** Sime, D.G.; Garcia, C.; Yasukawa, E.; Lundin, E.; Rock, K. (National Center for Atmospheric Research, Boulder, CO (USA)). Oct 1986. 73p. (NCAR/TN—274-STR). NTIS, PC A04/MF A01.

The synoptic observing program of the Mauna Loa Solar Observatory (MLSO) has as its goal the specification of the time-dependent structure of the solar corona. The growth of the low intensity polar regions and ordering of the brighter corona into a band near the equator seen in the second, third, and fourth years of observations (1981-1983) continued through 1984. In 1985, the corona remains in the same general form, with the brightest regions concentrated in a band around the equator, similar to the situation noted near the last solar minimum. The apparent excursions of the darkest regions (polar holes) towards the equator seen at the start of the year become less pronounced with time. However, the area embraced by the highest brightness contours tends to increase throughout the year, perhaps indicating that the corona has gone through its minimum configuration. The material presented here is in a format providing a convenient access to investigators intending to make correlation studies or an intercomparison of standard synoptic data sets.

23767 **(UWThPh—1986-41) Little night-physics.** Thirring, W. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701607.

Some thoughts are given to the antropic principle and its traces in physics.

23768 **(UWThPh—1986-46) Black holes with supercharge.** Aichelburg, P.C. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701611.

A review is given of what is known about stationary black hole configurations with non-zero supercharge in N=1 and N=2 supergravity.

23769 **Cosmological baryon production in spontaneous-CP-violating models without strong CP problem.** Cheng, H. (Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *D: Particles and Fields;* **34**: No. 12, 3824-3830(15 Dec 1986).

We study the cosmological baryon production in two different classes of spontaneous-CP-violating models with no strong CP problem. All known realistic models predict a large ΔB in the range required by the observed baryon asymmetry. In the first class of models in which CP violation is transmitted from the grand-unification scale down to the low-energy sector through fermion mixing effects, baryon asymmetry arises from the nonunitarity of the transformation matrices. It is pointed out that there is no dangerous flavor-changing neutral current due to Z-boson exchanges in the Nelson-type models. Weak CP-odd interactions are mediated by colored scalars in the second class of models. Large matter-antimat-

ter asymmetry can result from the decays of superheavy leptoquark scalars or from the decays of color-triplet Higgs bosons into a superheavy and light fermion.

23770 **Probing the structure of the universe from quarks to cosmology.** Kolb, E.W.; Quigg, C. (NASA/Fermilab Theoretical Astrophysics Group, Fermi National Accelerator Laboratory, Batavia, Illinois). *Physics Teacher;* **24**: No. 9, 528-539(Dec 1986).

The study of fundamental physical systems in the laboratory has implications for the evolution of our Universe as a whole. The next step toward an ultimate understanding of the Universe requires a powerful new instrument for the study of the physics of elementary particles: the Supercoducting Supercollider.

23771 **Globular clusters.** King, I.R. (Univ. of California, Berkeley). *Scientific American;* **252**: No. 6, 78-88(Jun 1985).

Throughout the 20th century, moreover, the study of globular clusters has led to fundamental advances in many branches of astronomy. In part because the clusters are so luminous their spatial distribution has helped investigators to stake out the frontiers of the Milky Way and of other galaxies; it has even been suggested that the clouds of gas that engendered globular clusters were the building blocks from which galaxies were made. Furthermore, all stars in a given cluster can be assumed to be the same age, and so the types of stars in clusters offer general insight into how stars evolve and why they differ in color and brightness. Finally, globular clusters bear on the evolution of the universe itself. They are the oldest objects known, dating perhaps from just after the big bang; as a result their ages impose severe observational constraints on cosmological models, and their chemical composition is evidence of the composition of galaxies at the earliest stage of development. 7 figures.

23772 **Collective capture of released lithium ions in the solar wind.** Winske, D.; Wu, C.S.; Li, Y.Y.; Zhou, G.C. (Los Alamos National Lab., NM). *Journal of Geophysical Research;* **89**: No. A9, 7327-7330(1 Sep 1984).

The capture of newly ionized lithium ions in the solar wind by means of electromagnetic instabilities is investigated through linear analysis and computer simulation. Three instabilities, driven by a lithium velocity ring perpendicular to and drifting along the magnetic field, are considered. The capture time of the lithium by the solar wind is roughly 10 linear growth times, regardless of whether resonant or nonresonant modes dominate initially. Possible implications of the results for the Active Magnetosphere Particle Tracer Explorer (AMPTE) mission are discussed. 18 references, 3 figures.

23773 **Cosmology, inflation, and supersymmetry.** Albrecht, A.; Fischler, W.; Steinhardt, P.J.; Dimopoulos, S.; Kolb, E.W.; Raby, S. (Pennsylvania Univ., Philadelphia; Harvard Univ., Cambridge, MA; Los Alamos National Lab., NM). pp 511-525 of Proceedings of the third Marcel Grossmann meeting on general relativity. Part A. Hu Ning (ed.). Amsterdam, Netherlands; North-Holland (1983). (CONF-820882—).

From 3. Marcel Grossman meeting on the recent developments of general relativity; Shanghai, China (28 Aug 1982).

Cosmological consequences of supersymmetric grand unified models based on the Witten-O'Raifeartaigh potential are discussed. In particular the authors study the development of the phase transition in the spontaneous breaking of supersymmetry. They find that in realistic models where light fields feel supersymmetry breaking only through coupling to massive fields, e.g., the Geometric Hierarchy model, the transition does not produce sufficient entropy. Thus, the standard cosmological flatness, monopole, and horizon problems remain. In addition, it is found that the transition is never completed, in the sense that the universe remains dominated by coherent Higgs field energy, resulting in an apparent matter dominated universe with $\Omega > \text{or} - 10^{30}$. (Auth.).

23774 **History of x-ray transients as seen by Vela, 1969-1979.** Terrell, J.; Priedhorsky, W.C.; Belian, R.D.; Conner, J.P.; Evans, W.D. (Los Alamos National Lab., NM). *Annals of the New York Academy of Sciences;* **422**: 282-283([1987]).

During the 10-year lifetime of the x-ray detectors, the Vela spacecraft provided data on many new types of sources. Cen X-4, an exceedingly bright x-ray transient, was observed in the summer of 1969, shortly after launch, and did not return to the x-ray sky until May 1979, when it was again observed by Vela 5B. This source also produced the first of many x-ray bursts detected by Vela, the bright, hard, precursor observed on 7 July 1969. The vela gamma-ray detectors revealed the new phenomenon of gamma-ray bursts. It has recently been found that at least two gamma-ray bursts were also detected by the x-ray counters. The data produced by Vela 5B over the 7-year period May 1969 - June 1976, during which real-time tracking was reasonably complete, have been put into the form of a series of 10-day x-ray sky maps. Although the Vela x-ray detectors were relatively small (27 cm^2 effective area), they were sensitive enough to yield good data on Cen A (NCC 5128) during the period 1973-1975 when it was unusually bright and active. The Vela data show that Cen A often changed dramatically in intensity in less than 10 days. 11 references.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 23764, 23789

23775 **(AD-A—175695/6/XAB) Ionospheric plasma study. Final report, 28 February 1983-28 February 1986.** Chang, T. (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Sep 1986. 192p. NTIS, PC A09/MF A01.

This report concerns plasma instabilities, ionospheric turbulence, and particle-energization processes in the magnetosphere and ionosphere. The following are examples for which theoretical explanations have been obtain: ion conics, effects of magnetic shear on the beam-induced instability, pitch-angle diffusion, wave-particle interactions, nonclassical polar wind, and strong plasma turbulence. Specific topics include: 1. Ion acceleration by lower-hybrid waves in the topside ionosphere. 2. Transverse acceleration of oxygen ions in the central plasma sheet region by electromagnetic ion-cyclotron resonance with broad-band left-hand polarized waves. 3. Analytic description of ion conics in the inhomogeneous terrestrial magnetic field. 4. Effect of magnetic shear on the nonlocal stability of beam-induced lower-hybrid waves. 5. The loss cone population of charged particles in the magnetosphere. 6. Charged particle injection experiments in space. 7. Critical fluctuations around non-equilibrium states and strong turbulence. 8. Heat-flux distribution and associated instabilities in the polar wind and solar wind.

23776 **(AD-A—175730/1/XAB) Modeling substorm current sytems using conductivity distributions inferred from DE (Dynamics Explorer) auroral images.** Kamide, Y.; Craven, J.D.; Frank, L.A.; Ahn, B.H.; Akasofu, S.I. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Oct 1986. 24p. NTIS, PC A02/MF A01.

Published in J. of Geophysical Research, Vol. 91, No. A10, 11235-11256(1 Oct 1986).

Images of auroral emissions observed with Dynamics Explorer 1 (DE 1) are used to calculate ionospheric conductivities over the polar region. The combination of ground-based magnetometer data and the inferred conductivities estimate, on a global scale, the distributions of ionosphere electric fields and currents and field-aligned currents, as well as the Joule-heating production rate, with a time resolution of 12 min. Although the inference of the conductivity distribution requires further improvements, the following conclusions may be drawn from this work: (1) The westward electrojet is in general collocated with the region of high auroral luminosity while the region of relatively low luminosity in the evening sector is collocated with the eastward electrojet. (2) The upward field-aligned currents exist in the brightest auroral region on the poleward side of the evening auroral oval and on the equatorward side of the morning oval. However, the magnitudes of these upward currents are not in proportion to the auroral luminosities, suggesting that the characteristic energies of precipitating electrons carrying the upward currents and generating the auroral luminosities may be different. (3) A significant amount of ionospheric currents can flow in regions where there are no bright auroral emissions. An example of this effect is found over the poleward half of the westward electrojet in the morning sector

where the electric field is the main contributor to the ionospheric currents. (4) The distribution of calculated field-aligned currents displays many localized structures that characterize the development of the substorm current system.

23777 **(AD-A—175734/3/XAB) Global auroral responses to magnetospheric compressions by shocks in the solar wind: two case studies.** Craven, J.D.; Frank, L.A.; Russell, C.T.; Smith, E.J.; Lepping, R.P. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1986. 15p. NTIS, PC A02/MF A01.

Published in Geophysical Research Letters, Vol. 13, No. 8, 873-876(1986); Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Two case studies are presented of the global auroral responses to shocks in the solar wind at Earth. The z component of the interplanetary magnetic field, Bz, is negative ahead and behind the first shock and positive for the second case. A sudden-commencement geomagnetic storm develops in each case, with maximum D/sub st/ < or = 190 nT. An immediate auroral response is detected at all longitudes around the auroral oval, in which auroral luminosities increase by a factor of 2 to 3 with the first samples after each sudden commencement. The time delay in obtaining the first sample varies with local time from approx 1 to 18 minutes. No other significant variations in the aurorae are associated with the immediate response. Beginning about 30 minutes after each sudden commencement, the aurorae become active and display significant variations in luminosity and spatial distribution. For B/sub z/ < 0 an intense substorm develops. A sun-aligned transpolar arc forms when B/sub z/ > 0, appearing first at local midnight as a polar arc and then lengthening sunward from the auroral oval across the polar cap to noon at an average speed of about 1 km/sec.

23778 **(AD-A—175756/6/XAB) Kinetic model of auroral plasma formation II: simultaneous multi-satellite ion observations and interpretations. Technical report.** Chiu, Y.T.; Lennartsson, O.W.; Korth, A.; Kremser, G.; Fennell, J.F. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 30 Sep 1986. 52p. (TR—0086(6940-05)-4). NTIS, PC A04/MF A01.

A detailed analysis of ion composition and distribution observed simultaneously by GEOS 2, SCATHA, and ISEE 1 satellites at the initial phases of an injection event in the inner magnetosphere was made. The mean convection electric field observed by GEOS 2 during the data interval was used to determine the space-time variation of a global time-dependent convection electric-field model, which is approximately verified in this report by ISEE 1 plasma flow measurements and by the unusual SCATHA observation of low-energy ions convected from the plalsmasphere cloak region. Theoretical tracing of ion trajectories with the tested electric-field model indicates that multi-satellite observations of keV ion dispersion can be interpreted in terms of a collision/mixing between an injected auroral ion population rich in oxygen with a preinjection population rich in hydrogen and doubly-ionized helium which had previously moved inward from ISEE 1 orbit. The results of this collision/mixing was that ion dispersion signatures afterwards appeared as if they were from a single population, having lost memory of their previous convection history. This is a possible formulation mechanism of the ad hoc injection boundary which is marked only by plasma dispersion signature and not by any other magnetospheric feature.

23779 **(AD-A—175799/6/XAB) Velocity distributions of ion beams in the plasma-sheet boundary layer. Progress report.** Eastman, T.E.; DeCoster, R.J.; Frank, L.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1986. 12p. NTIS, PC A02/MF A01.

Published in Geophysical Monograph, Ion Acceleration in the Magnetosphere and Ionosphere, No. 38, 117-126(1986).

Field-aligned ion beams commonly occur in the plasma-sheet boundary layer. With sufficient energy and angular resolution, plasma measurements of ion-beam velocity distributions there can be used as a diagnostic tool to evaluate ion-acceleration processes. Model fits to data are shown for adiabatic deformation of a flowing Maxwellian, acceleration due to field-aligned potentials, and current-sheet acceleration. Isodensity contours of the velocity distributions typically show a closer spacing within the low-energy portion of the ion beams that is not consistent with adiabetic deformation alone acting upon an initially isotropic distribution function. Detailed comparisons of acceleration models with the overall shapes of the observed beam distributions indicate that the ion beams were subjected to some potential drop that may be field-aligned or perhaps cross tail as for the current-sheet acceleration process. Measurements of velocity-dispersion effects have also proven to be a useful diagnostic tool although propagation effects are difficult to separate from signatures of the initial acceleration process. Ion-acceleration processes in the magnetotail are primarily associated with the plasma-sheet boundary layer.

23780 **(AD-A—175914/1/XAB) Characteristics of polar-cap precipitation and their dependence on the interplanetary magnetic field and the solar wind.** Hardy, D.A.; Gussenhoven, M.S.; Riehl, K.; Burkhardt, R.; Heinemann, N. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 31p. (AFGL-TR—87-0002). NTIS, PC A03/MF A01.

Published in Solar Wind-Magnetosphere Coupling, 575-604(1986).

Work completed on the nature of the precipitation occuring in the polar cap and its relationship to the state of the solar wind and the interplanetary magnetic field is reviewed. This work has shown that there are two states of polar-cap precipitation; an active state occurring when the IMF B/sub z/ component is positive in which polar showers or polar squalls occur over much of the cap and a quiet state occurring when the IMF B/sub z/ is negative in which only the unperturbed polar rain is observed. The two states occur with approximately equal frequency. The characteristics of both the precipitating electrons and ions for the two states and the variation in these characteristics with the orientation of the IMF and the state of the solar-wind plasma are discussed along with the implications of these observations as to the mechanisms leading to these two states.

23781 **(AD-A—175915/8/XAB) Dynamics of the equatorward boundary of the auroral oval.** Nakai, H.; Kamide, Y.; Hardy, D.A.; Gussenhoven, M.S. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 11p. (AFGL-TR—87-0001). NTIS, PC A02/MF A01.

Published in Solar Wind-Magnetosphere Coupling, 633-641(1986).

The Auroral Boundary Index determined on the basis of DMSP precipitating-electron data is used to examine the expansion and contraction of the auroral oval in the midnight sector. The time scales of the expansion and the contraction of the auroral oval are found to be about 45 minutes and 8 hours, respectively. An empirical formula including these two time scales to predict the oval location from variations in the interplanetary magnetic field (IMF) is devised. The correlation coefficient between the measured and the predicted boundary is 0.82.

23782 **(AD-A—175975/2/XAB) Spectral characteristics of interchange turbulence in the ionosphere. Memorandum report.** Hassam, A.B.; Hall, W.; Huba, J.D.; Keskinen, M.J. (Science Applications International Corp., McLean, VA (USA)). 22 Oct 1986. 55p. NTIS, PC A04/MF A01.

The spectral characteristics of turbulence associated with the magnetized-plasma Rayleigh-Taylor instability in the presence of a background neutral gas are studied. Particular attention is paid to comparing the spectra obtained in the ion-neutral collision-dominated case with the spectra from the ion inertia-dominated case. A saturated level of turbulence is obtained for a model system confined between conducting boundaries with an imposed density gradient between the boundaries. The potential spectrum in the collisional case shows a marked anisotropy in contrast to that in the inertial case which is isotropic and exhibits Kolmogorov scaling. The anisotropy in the collisional case is attributed to the viscous nature of the turbulence and the consequent suppression of inertial overshoots. Application of these results to ionospheric turbulence is discussed.

23783 (AD-A—176009/9/XAB) Limiting energy spectrum of a saturated radiation belt. Technical report. Schulz, M.; Davidson, D.T. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 30 Sep 1986. 53p. (TR—0086(6940-06)-6). NTIS, PC A04/MF A01.

A reformulation of the nonrelativistic Kennel-Petschek problem for electrons and protons enables a limiting energy spectrum to be derived, such that (for specified pitch-angle anisotropy s of the energetic-particle population) electromagnetic cyclotron waves at each frequency less than a fraction s/(s+1) of the equatorial gyrofrequency are marginally stable against spontaneous generation. The limiting spectrum is given in closed form for integer values of s and computed numerically for non-integer values of s. Asymptotic expansions for energies E barely above and much greater than the minimum resonant energy E provides estimates of the limiting energy spectrum J_4 pi (E) in these extremes, regardless of whether s is an integer. A reconsideration of the original Kennel-Petschek problem, in which the differential energy spectrum is not calculated but specified as a certain power law (J_4 pi E to the 1-l power), enables the wave frequency corresponding to maximum spatial growth rate, as well as the limiting integral flux I/sub 4p/ above the minimum resonant energy E, to be calculated in closed form as functions of l and s.

23784 (INIS-SU—401, pp 46-50) Production of secondary electrons by radiation belt protons in the region of the Brazil magnetic anomaly. Nikol'skij, S.I.; Sinitsina, V.G. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

Elevated albedo of electrons with the energy >= 100 MeV is found in the region of the Brazil magnetic anomaly that serves as a source for capture and quasicapture of electrons of the above energy by the magnetic field of the Earth. Elevated flow of albedo electrons in the region of the Brazil magnetic anomaly should be reflected not only on the intensity of the trapped electron flow in the Earth radiation belt, but on the flow of quasitrapped electrons, longitude dependence of flow intensity. The flow of quasitrapped electrons in this case is maximum to the east of Brazil magnetic anomaly. In its further longitude drift the excess of quasitrapped electron flow formed by large albedo electron flow from the radiation belt protons in the region of the Brazil magnetic anomaly is absorped and intensity of quasitrapped electrons becomes close to intensity of the albedo electron flow out of the region of the Brazil anomaly (50 +- 5) msup(-2)ssup(-1)srsup(-1).

23785 (OUP—86-17) From the sun's corona to the polar cusp aurora above Svalbard. Interplanetary and terrestrial effects of a coronal transient. Sandholt, P.E. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750683.

The report presents a study of the flare-related coronal transient of Nov. 27, 1979, with the resulting interplanetary (IP) shock, and the associated auroral and magnetic effects that were observed from the ground 72 hours after the initial coronal brightening. The observed disturbance of the interplanetary magnetic field (IMF) resulting from the coronal mass ejection is discussed in relation to a model discription of flare-related perturbations of the solar current sheet. The power transfer from the solar wind to the magnetosphere did not rise above the treshold value for magnetospheric strom triggering in this case. thus, the IP shock was not followed by a major storm. However, distinct signatures related to the IP disturbance were observed in the polar cusp aurorae above Svaldbard and in the local magnetic field. The dynamical behaviour of the cusp aurora is discussed in relation to different models of plasma transfer across the dayside magnetopause, from the shocked solar wind to the magnetosphere. A detailed analysis of the available information from interplanetary space and the ground indicates that the main auroral dynamics observed in this case are related to localized, impulsive plasma injections associated with flux transfer events. 55 refs.

23786 Injection of an electron beam into a plasma and spacecraft charging. Okuda, H.; Kan, J.R. (Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, New Jersey 08544). *Physics of Fluids;* **30**: No. 1, 209-220(Jan 1987).

Injection of a nonrelativistic electron beam into a fully ionized plasma from a spacecraft including the effect of charging has been studied using a one-dimensional particle simulation model. It is found that the spacecraft charging remains negligible and the beam can propagate into a plasma, if the beam density is much smaller than the ambient density. When the injection current is increased by increasing the beam density, significant spacecraft charging takes place and the reflection of beam electrons back to the spacecraft reduces the beam current significantly. On the other hand, if the injection current is increased by increasing the beam energy, spacecraft charging remains negligible and a beam current much larger than the thermal return current can be injected. It is shown that the electric field caused by the beam—plasma instability accelerates the ambient electrons toward the spacecraft thereby enhancing the return current.

23787 High-resolution studies of the HF ionospheric modification interaction region. Duncan, L.M.; Sheerin, J.P. (Los Alamos National Lab., NM). *Journal of Geophysical Research;* **90**: No. A9, 8371-8376(1 Sep 1985).

Incoherent backscatter radar studies were conducted of the HF ionospheric modification interaction region using the facilities of the Arecibo Observatory. Very high relative spatial and temporal resolutions were achieved. These measurements resolve the miniovershoot (2-10 ms after HF on) and main overshoot (20-40 ms after HF on) plasma wave excitation features. The main overshoot phenomenon is observed to develop very reproducibly with enhancements of a factor of 10 greater than the steady state HF-enhanced plasma line intensity. However, this main overshoot effect is strongly suppressed for HF off times of less than 100 ms. In general, the miniovershoot excitation is found to occur 800-1000 m below the main overshoot excitation height. In addition, in one case, a small plasma line enhancement is detected at very early times (< 1 ms) distinct from the miniovershoot and originating at a greater height. The main overshoot and the steady state enhanced plasma line both develop at essentially the same altitude. However, the interaction layer is observed to broaden by several hundred meters during the main overshoot relaxation. Possible explanations for these effects are proposed using a combination of the theories of soliton formation and collapse, wave ducting, profile modification, parametric instabilities, and other interactive processes. 25 references, 6 figures.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 22878, 22922, 23138, 23553, 24128, 24129, 24130, 24131, 24132

23788 (AD-A—175692/3/XAB) Dynamics of cluster dissociation following multiphoton ionization. Castleman, A.W. (Pennsylvania State Univ., University Park (USA). Davey Lab.). 1986. 6p. NTIS, PC A02/MF A01.

Pub. in Advances in Laser Science, ser 6, 483-487(1986).

A major advance in the study of unimolecular dissociation and the spectroscopy of clusters has become available through the use of multiphoton ionization coupled with a reflectron introduced into the drift region of a time-of-flight mass spectrometer. Using single and two-color tunable pulsed lasers, the excess energy introduced into a cluster can be well controlled. The power of this method is demonstrated by the results of recent investigations of hydrogen-bonded clusters which, following ionization, lead to an internal ion-molecule reaction, and cluster fragmentation. The role of dissociation and the influence of the thermochemical stability of cluster ions in effecting the appearance of magic numbers in certain cluster distributions is discussed. The application of this method in determining ionization potentials of probe molecules following successive clustering with a solvent species is also presented.

23789 (AD-A—175727/7/XAB) Atomic collisions and plasma physics. Final report, 1 July 1983-30 June 1986. Biondi, M.A.; Johnsen, R. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). 31 Aug 1986. 16p. NTIS, PC A02/MF A01.

Experimental studies were carried out of ion-molecule reactions and of electron-ion recombination of interest for modeling the normal and disturbed regions of the earth's upper atmosphere. Drift tube and microwave afterglow techniques were employed for these studies. Rates were determined for the oxidation reactions of zirconium ions, and theoretical models for the temperature dependence of three-body diatomic ion/diatomic gas were developed. The electron-temperature dependence of the recombination of NO^+ and NO^+ ions has been measured over a wide range of electron temperatures.

23790 (AD-A—175751/7/XAB) Interaction of an adsorbed atom with a laser. Technical report. Arnoldus, H.F.; van Smaalen, S.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Dec 1986. 60p. (UBUFFALO/DC—86/TR-23). NTIS, PC A04/MF A01.

The irradiation by infrared laser light of an atom adsorbed on the surface of a harmonic crystal is considered. The dynamic coupling between the atom (its motion) and the substrate degrees of freedom (phonon field) in the presence of a confining potential well (van der Waals bond between atom and crystal) gives rise to thermal relaxation of this adbond configuration. Both the atom and the substrate are assumed to be transparent, but the bond is allowed to have non-vanishing dipole-moment matrix elements, which couple the external field to the adsorbate. The equation of motion for the reduced adbond density operator is obtained with reservoir theory, and the relaxation constants are expressed in properties of the crystal. With a similar method, the spectral profile for absorption of weak radiation is derived. Subsequently, the illumination by a strong finite-linewidth laser field which is in close resonance with a single transition of the adbond is examined. The optical Bloch equations in operator torm are derived and applied to study the process of laser heating of the crystal. It is pointed out how this mechanism can be understood as resulting from (multi)photon-phonon conversion reactions which are mediated by the adbond.

23791 (BNL—39373) A sputtering derived atomic oxygen source for studying fast atom reactions. Ferrieri, R.A.; Chu, Y.Y.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 10 Nov 1986. Contract AC02-76CH00016. 8p. (CONF-8611131—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006465.

From NASA workshop on atomic oxygen effects; Pasadena, CA, USA (10 Nov 1986).

A novel technique for generation of fast atomic oxygen has been developed. These atoms are created by ion beam sputtering from metal oxide surfaces. Mass resolved ion beams at energies up to 60 KeV are produced for this purpose using a 150 cm Isotope Separator. Studies have shown that particles sputtered with 40 KeV Ar^+ on Ta_2O_5 were dominantly neutral and exclusively atomic. The atomic oxygen also resided exclusively in its ^3P ground-state. The translational energy distribution for these atoms peaked at ca 7 eV (the metal-oxygen bond energy). Additional measurements on V_2O_5 yielded a bimodal distribution with the lower energy peak at ca 5 eV coinciding reasonably well with the metal-oxygen bond energy. The 7 eV source was used to investigate fast oxygen atom reactions with the 2-butene stereoisomers. Relative excitation functions for H-abstraction and π-bond reaction were measured with trans-2-butene. The abstraction channel, although of minor relative importance at thermal energy, becomes comparable to the addition channel at 0.9 eV and dominates the high-energy regime. Structural effects on the specific channels were also found to be important at high energy. 11 refs., 2 figs.

23792 (CONF-860316—13) Multiphoton ionization in intense ultraviolet laser fields. Johann, U.; Luk, T.S.; McIntyre, I.A.; McPherson, A.; Schwarzenbach, A.P.; Boyer, K.; Rhodes, C.K. (Illinois Univ., Chicago (USA). Dept. of Physics). Mar 1986. Contract AC02-83ER13137. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004729.

From Topical meeting on short wave length coherent radiation; Monterey, CA, USA (24 Mar 1986).

The mechanism of collision-free multiphoton ionization of rare gases irradiated with ultraviolet radiation at an intensity of up to $\sim 10^{16}$ W/cm^2 at 248 nm and a pulse length of $\sim$0.5 ps and $\sim 10^{15}$ W/cm^2 at 193 nm and $\sim$5ps, respectively, has been studied by observing the electron energy spectra and ion charge state threshold intensities. The formation of multiply charged ions by a sequential process of ionization has been directly detected in the electron energy spectra in the form of a characterisitic pattern of interwoven above threshold ionization (ATI) ladder line series. The threshold intensities for ion production have been compared with the Keldysh model and were found to be in good agreement for light ions (Ne) and consistently lower for heavier ions (Xe), scaling with the atomic number. These measurements, together with estimates of the ion population dynamics during the rise of the laser pulse can be reasonably understood on the basis of a single electron picture. 16 refs., 5 figs.

23793 (CONF-870152—1) High charge state, ion-atom collision experiments using accel-decel. Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Graham, W.G. (Western Michigan Univ., Kalamazoo (USA). Dept. of Physics; Ulster Univ., Coleraine (UK). Dept. of Physics). 1987. Contract AC02-83ER13116. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005814.

From Workshop on opportunities for atomic physics using slow highly-charged ions; Argonne, IL, USA (12 Jan 1987).

Recent studies of $_{16}S^{13+}$ + He collisions between 2.5 and 200 MeV, which were made using the accel-decel technique with the Brookhaven National Laboratory coupled MP tandem Van de Graaff accelerators, are discussed. Cross sections were measured for single electron-capture and -loss as well as K x rays correlated to electron-capture. Other planned ion-atom collision experiments requiring accel-decel are also presented. 18 refs., 3 figs.

23794 (CONF-8609244—1) Faraday discussion No. 82: Dynamics of molecular photofragmentation: Comment on papers No. 4 and No. 10. O'Halloran, M.A. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004671.

From Dynamics of molecular photofragmentation conference; University of Bristol, UK (15 Sep 1986).

The polarization response of the laser-induced fluorescence probe of the CN fragment produced in the photodissociation of ICN at 249 nm. The response was measured with the detector in two experimental configurations (parallel and perpendicular to the polarization of the laser). A small discrepancy was observed between the alignments as determined for the two experimental configurations. This discrepancy occurred since the laser was narrower than the Doppler width of the transition, thus only molecules with velocity projections on the probe were observed. (WRF)

23795 (CONF-8609252—2) Transfer ionization in 0.5-1.5 MeV/u O^{5-8+} + He collisions. Tanis, J.A.; Clark, M.W.; Price, R.; Ferguson, S.M.; Olson, R.E. (Western Michigan Univ., Kalamazoo (USA); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.); Missouri Univ., Rolla (USA)). 1986. Contract AC02-83ER13116. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87005810.

From Conference on the physics of multiple charged ions; Groningen, Netherlands (17 Sep 1986).

Transfer ionization (TI), in which electron capture is accompanied by loss of the other electron from the target, been measured for 0.5 to 1.5 MeV/u 0/sup q/$^+$ ions (q = 5-8+) colliding with helium. These new measurements, in conjunction with previous measurements at lower energies, are used to formulate a scaling rule to describe the projectile energy and charge state dependences of TI for collisions involving helium targets. 10 refs., 2 figs.

23796 (CONF-8609252—3) L-shell resonant transfer and excitation for NE-like niobium ions. Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Graham, W.G.; McFarland, R.H.; Mowat, J.R.; Mueller, D.W.; Stockli, M.P.; Berkner, K.H.; McDonald, R.J. (Western Michigan Univ., Kalamazoo (USA). Dept. of Physics; Ulster Univ., Coleraine (UK). Dept. of Physics; Missouri Univ., Rolla (USA). Dept. of Physics; North Carolina State Univ., Raleigh (USA). Dept. of Physics; Louisiana State Univ., Baton Rouge (USA). Dept. of Physics; Kansas State Univ., Manhattan (USA). Dept. of Physics). Sep 1986. Contract AC02-83ER13116. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005911.

From Conference on the physics of multiple charged ions; Groningen, Netherlands (17 Sep 1986).

Projectile excitation and charge transfer (capture) can occur simultaneously in a single encounter with a target atom through the electron-electron interaction between a projectile electron and a weakly bound target electron. This process is referred to as resonant transfer and excitation (RTE). L-shell RTE has been investigated for 230 to 610 MeV Nb^{31+} (neonlike) ions incident on H_2. 11 refs., 1 fig. (WRF)

23797 (CONF-8609257—1) Electron-impact ionization data for the Fe isonuclear sequence. Pindzola, M.S.; Griffin, D.C.; Bottcher, C.; Younger, S.M.; Hunter, H.T. (Oak Ridge National Lab., TN (USA); Auburn Univ., AL (USA); Rollins Coll., Winter Park, FL (USA); Lawrence Livermore National Lab., CA (USA)). 25 Nov 1986. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87004420.

From IAEA advisory group meeting on atomic data for fusion plasma modelling; Vienna, Austria (18 Sep 1986).

Atomic data for the electron-impact ionization of ions in the Fe isonuclear sequence is reviewed. The best available data are identified. Comments are made on current research activities leading to future data for Fe ions. 23 refs., 29 figs., 12 tabs.

23798 (CONF-8611124—4) Correlated double electron capture in slow, highly charged ion-atom collisions. Stolterfoht, N.; Havener, C.C.; Phaneuf, R.A.; Swenson, J.K.; Shafroth, S.M.; Meyer, F.W. (Oak Ridge National Lab., TN (USA); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1986. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007375.

From 3. international workshop on cross sections for fusion and other applications; College Station, TX, USA (6 Nov 1986).

Recent measurements of autoionization electrons produced in slow, highly charged ion-atom collisions are reviewed. Mechanisms for double electron capture into equivalent and nonequivalent configurations are analyzed by comparing the probabilities for the creation of $L_1L_{23}X$ Coster Kronig electrons and L-Auger electrons. It is shown that the production of the Coster-Kronig electrons is due to electron correlation effects whose analysis leads beyond the independent-particle model. The importance of correlation effects on different capture mechanisms is discussed. 28 refs., 6 figs.

23799 (DOE/ER/13394—4) Studies of autoionizing states relevant to dielectronic recombination: Progress report, July 1, 1986-June 30, 1987. Gallagher, T.F. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Mar 1987. Contract FG05-85ER13394. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007765.

Systematic studies of the Sr 5pns and 5pnd autoionizing states are described. Specifically the experimental determination of energy levels and autoionization rates and interchannel interaction from the total excitation spectra is described as well as the quantum defect theory analysis of these diverse data leading to the determination of a few physically significant parameters. In addition measurements of the angular and energy distributions of the ejected electrons using a recently constructed energy analyzer are described. Finally, the development of the theoretical framework to analyze these data is described.

23800 (DOE/ER/13549—T1) Electron transfer ionization and excitation in atomic collisions: Progress report. Winter, T.G. (Pennsylvania State Univ., University Park (USA). Dept. of Physics). 15 Feb 1987. Contract FG02-86ER13549. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006659.

A brief summary is presented on the theoretical research on atomic collision processes of electron transfer, ionization, and excitation. (WRF)

23801 (GSI—86-25-Prepr.) Spectroscopy of heavy few-electron ions. Mokler, P.H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1986. 31p. (CONF-8607101—2-Prepr.). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751184.

From 18. europhysics conference of the European Group for Atomic Spectroscopy (EGAS-18); Marburg, F.R. Germany (8 Jul 1986).

In this paper we ask first, why is it interesting to investigate heavy-few electron ions. Then the various accelerator-based methods to produce heavy few-electron ions are discussed. In the main part an overview on available heavy few-electron ion data and current experiments is given. The summary will end up with future aspects in this field.

23802 (GSI—86-33-Prepr.) Experimental summary. Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Sep 1986. 20p. (CONF-8606183—8-Prepr.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751185.

From NATO international advanced course on physics of strong fields; Maratea, Italy (1 Jun 1986).

The author reviews the experimental results on positron production in heavy ion collisions. (HSI).

23803 (GSI—86-34-Prepr.) Anomalous positron emission in heavy ion-collisions. Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Sep 1986. 17p. (CONF-860833—4-Prepr.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751229.

From 10. international conference on atomic physics; Tokyo, Japan (25 Aug 1986).

In section two we shortly present the experimental methods and first results on positron lines. Section three deals with the dependence of the positron line production on the charge of the collision system, bombarding energy and scattering angle. The results of the first e/sup +/-e/sup -/-coincidence studies are reviewed in section 4. In the last paragraph we make some remarks on future developments of the experimental methods.

23804 (IC—86/157) Elastic scattering of electrons from inert gases: 5. Argon and krypton in the vicinity of Ramsauer-Townsend minima and on the choice of pseudo-states. Fon, W.C. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701524.

Recently, several electron scattering experiments using improved experimental techniques have been reported for Ar and Kr in the region of Ramsauer-Townsend minima. The calculations of Fon et al. on electrons colliding with inert-gas atoms are extended to examine these experimental data. These calculations using a single pseudo-state to account for the dipole polarisability of the ground state atom while ignoring a whole host of excitation mechanisms, have been the subject of considerable controversy (e.g. Reinhardt 1981; Walters 1981). The answers to the questions raised by Walters (1981) may well lie in the present calculation and those of Fon et al. (1983, 1984) in which the /sup 1/P pseudo-states used in these calculations give polarisabilities at least 15% larger than the experimental values. 45 refs, 6 figs, 6 tabs.

23805 (IC—86/231) Time evolution of vibrational states of hydrogen molecule adsorbed on Fe(111) surface. Gryko, J. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701548.

A simple model of hydrogen molecule interacting with two surface atoms is used to study the time evolution of the population of vibration levels of the hydrogen molecule. 5 refs, 7 figs.

23806 **(IC—86/242) Energy levels of the single excited states in the boron isoelectronic sequence.** El-Sherbini, T.M.; Mansour, H.M.M.; Farrag, A.A.; Rahman, A.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701553.

Energy levels of the single excited 1S/sup 2/2S/sup 2/ns(/sup 2/S), 1s/sup 2/2s/sup 2/np(/sup 2/P), 1s/sup 2/2s/sup 2/nd(/sup 2/D) and 1s/sup 2/2s/sup 2/nf(/sup 2/F), n=3-8 states for the boron isoelectronic sequence are calculated using the simple configuration Hartree-Fock method. Good agreement is obtained between our results and previous experimental and theoretical data. 9 refs, 3 figs, 15 tabs.

23807 **(IC—86/260) On the treatment of Moeller and Breit-potentials and the covariant two-body equation for positronium and muonium.** Barut, A.O. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701556.

A consistent non-perturbative treatment of the relativistic Moeller potential is proposed and the application of a covariant two-body equation derived from field theory to the spectra of positronium and muonium is discussed. 10 refs.

23808 **(INIS-mf—10325) Study of the positron production in uranium-uranium collisions.** Clemente, M. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 21 Jul 1983. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751196.

In the present thesis the positron production in the high Coulomb field of two /sup 238/U nuclei in the heavy ion collision for projectile energies in the range of the Coulomb threshold (5.7-6.2 MeV/u) was studied. The energy spectra of the positrons which were taken up in coincidence to the scattered particles exhibit unexpectedly lines. These are superposed to a continuous spectrum which can be well described by the calculated pair production in a time-dependent Coulomb field and from nuclear decays. The energy of the positron line varies in dependence on the incident energy and the particle scattering angle between 311+-7 keV (E/sub p/=5.73 MeV/u; θ/sub lab/=38/sup 0/-52/sup 0/) and 226 +- 17 keV (E/sub p/=6.2 MeV/u; θ/sub lab/=25.5/sup 0/-29/sup 0/). At fixed scattering angle around 42/sup 0/ in the laboratory system the line width grows with increasing incident energy from 56 +- 9 keV (5.73 MeV/u) to 219 +- 100 keV (6.2 MeV/u). In this angular range at 5.73 MeV/u and 5.9 MeV/u a maximum in the cross section is observed. For smaller scattering angles of 26/sup 0/ < or approx.θ/sub lab/< or approx.38/sup 0/ the positron spectrum shows at the lowest incident energy a smooth distribution while at the higher projectile energies also for these angles a line occurs. (orig./HSI).

23809 (INIS-mf—10589, pp 116-117) **Internal conversion electron spectroscopy used to non-destructive determination of /sup 99m/Tc valence state in solid samples.** Dragoun, O.; Fiser, M.; Brabec, V.; Kovalik, A.; Kuklik, A.; Rysavy, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23810 (INIS-SU—401, pp 55-59) **Additional effective mechanism of exciting multicharged ions in a dense plasma.** Ragozin, E.N. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

A new efficient mechanism of multicharged ion excitation in dense plasma is studied. The mechanism is conditioned by radiative-collision ionization of autoionization states of ion of the preceeding ionization ratio (X/sub Z/a/sub 0/+c -> X/sub Z-I//sup anl/ -> Xσ/sub Z/(a)+e).

23811 **(LA-UR—87-356) Muonium and MEGA.** White, D.H. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 21p. (CONF-8610183—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006050.

From LAMPF users group meeting; Los Alamos, NM, USA (1 Oct 1986).

Two types of experiments on muonium are described. The first measures the hyperfine structure interval in muonium, and the second measures the Lamb shift. Another type of experiment is described which searches for the transition $(\mu^+e^-)\rightarrow(\mu^-e^+)$. The MEGA experiment is then discussed which searches for the reaction $\mu \rightarrow e + \gamma$. 13 figs., 3 refs. (LEW)

23812 **(LBL—22640) The Lamb shift in heliumlike uranium (U^{90+}).** Munger, C.T. Jr. (California Univ., Berkeley (USA)). Jan 1987. Contract AC03-76SF00098. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006929.

An experimental value of 70.4 (8.3) eV for the one-electron Lamb shift in uranium is reported, in agreement with the theoretical value of 75.3 (0.4) eV. The Lamb shift is extracted from a beam-foil time-of-flight measurement of the 54.4 (3.4) ps lifetime of the 1s 2p/sub 1/2/ $^3P_0$ state of heliumlike (two-electron) uranium. 18 figs.

23813 **(NORDITA—84/39-Prepr.) Configurational statistics of a polymer chain with random sequence of elements.** Obukhov, S.P. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Oct 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751245.

It is shown that for a disordered polymer chain the upper critical dimension is d/sub c/=3. At $d \leqq 3$ the effect of randomness increases on large scales due to the space correlations of attractive and repulsive monomers, but it can also be screened by repulsive two- or three-body interaction. The renorm group equations indicate that near the theta point it can be the large dispersion of sizes of polymers which differ only in sequences of elements.

23814 **Spin—boson model for spectroscopy involving nonadiabatically coupled potential energy surfaces.** Coalson, R.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **86**: No. 2, 995-1009(15 Jan 1987). Contract W-7405-ENG-36.

A spin—boson model, analogous to models commonly used to study multidimensional tunneling, is formulated for the problem of computing optical spectra when nonadiabatically coupled Born—Oppenheimer surfaces are involved. The model is implemented numerically for a one-dimensional prototypical case. It is demonstrated that time kernels associated with low resolution electronic absorption spectra and Raman scattering cross sections can be obtained without excessive effort even in strong coupling regimes where perturbation expansions become inefficient. The outlook for extension to more complicated systems is discussed.

23815 **High intensity 5 eV CW laser sustained O-atom exposure facility for material degradation studies.** Cross, J.B.; Spangler, L.H.; Hoffbauer, M.A.; Archuleta, F.A. (Los Alamos National Lab., NM). *SAMPE (Society for the Advancement of Material and Process Engineers) Quarterly;* **18**: No. 2, 41-47(Jan 1987).

An atomic oxygen exposure facility was developed for studies of material degradation. The goal of these studies is to provide design criteria and information for the manufacture of long life (20 to 30 years) construction material for use in low earth orbit. The studies that are being undertaken using the facility will provide (1) absolute reaction cross sections for use in engineering design problems, (2) formulations of reaction mechanisms for use in selection of suitable existing materials and design of new more resistant ones, and (3) calibration of flight hardware (mass spectrometers, etc.) in order to directly relate experiments performed in low earth orbit to ground based investigations. 15 references, 10 figures.

23816 Direct determination of the stereochemical structure of CH_4i. Vager, Z.; Kanter, E.P.; Both, G.; Cooney, P.J.; Faibis, A.; Koenig, W.; Zabransky, B.J.; Zajfman, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **57**: No. 22, 2793-2795(1 Dec 1986). Contract W-31-109-ENG-38.

The use of the Coulomb-explosion technique combined with a new multiparticle detector, extremely thin targets, and low-excitation ion source has enabled a direct measurement of the complete stereochemistry of the CH_4^+ molecular ion. Preliminary analysis of the data gives a structure consistent with predictions of the Jahn-Teller-distorted ground state. We outline the techniques by which this method can be generalized to determine directly complex vibrational motions in polyatomic molecules.

23817 Between the local-mode and normal-mode limits. Scott, A.C.; Lomdahl, P.S.; Eilbeck, J.C. (Los Alamos National Lab., NM). *Chemical Physics Letters;* **113**: No. 1, 29-36(4 Jan 1985).

A simple model system is introduced for the vibrational analysis of polyatomic molecules. This classical system is based on complex mode amplitudes and reduces to either the normal-mode (NM) or the local-mode (LM) description in appropriate limits. Upon analysis without perturbative assumptions, the system exhibits sinusoidal, periodic, quasi-periodic and chaotic behaviors between the NM and the LM limits. 29 references, 4 figures, 1 table.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 24339

23818 (DOE/ER/13493—1) Theory of condensable gases: Progress report, March 15, 1986-February 28, 1987. White, J.A. (American Univ., Washington, DC). Nov 1986. Contract FG05-86ER13493. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007318.

A theory of the contribution of short to intermediate wavelength random fluctuations to thermodynamic properties has been worked through for a model system of interacting molecules. The object has been to obtain a simple but good first approximation to the thermodynamic behavior of real systems both near the critical point and over wide regions of temperature, density, and pressure in the surrounding gas, liquid, and supercritical phases. The simplest version of the model extends a modern variant of the mean field theory of Van der Walls by introducing a single new parameter that characterizes the finite range of the attractive intermolecular interactions. The theory thus contains the following three molecular parameters, including those of Van der Waals: b = volume of repulsive cores, a = energy-volume product for attractive interactions, and the new parameter, c = volume of attractive halos, i.e., the volume of the region of attractive interactions that surrounds the repulsive cores.

23819 (UCID—21006) Lagrangian-like equations of hydrodynamics with mass diffusion. Crowley, W.P. (Lawrence Livermore National Lab., CA (USA)). 14 Oct 1986. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007522.

The relation between mean kinetic energy and acceleration are derived by using an Eulerian representation of inviscid hydrodynamics. (WRF)

6450 High Energy Physics

23820 (INIS-mf—10589) Eighth conference of Czechoslovak physicists. Part I, Vol. 1. Sebesta, J.; Povinec, P. (eds.). (Jednota Ceskoslovenskych Matematiku a Fyziku, Prague). 1985. 132p. (In Czech, Slovak). (CONF-8508223—Pt.1-Vol.1). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626.

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

Conference papers were published in two parts. Part I contains the abbreviated texts of original contributions, part II the full texts of papers read at the plenary sessions and of invited papers. Part I was published in two volumes, volume 1 including contributions from the fields of elementary particle physics, nuclear physics, plasma physics, physics of metals and semiconductor physics. Of these, 66 papers falling into the INIS subject scope were inputted in INIS. (A.K.).

23821 (SLAC-PUB—4148-Extd.Ver.) Networking through the new phone system: The future of telecommunications. Struven, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1986. Contract AC03-76SF00515. 15p. (CONF-870249—1-Extd.Ver.). NTIS, PC A02. File Number DE87005972.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

This paper traces the history of the telephone system from 1850 to present, and describes the "new" telephone companies. The immediate problems of 56 KB data and 64 KB voice channels are discussed together with their proposed solution. The Integrated Digital System Network concept (IDSN) is described, and the proposals to build a true end-to-end digital telephone network are described. The Stanford University-Northern Telecom information test facility is described. The current and planned networks in the US and around the world have also been included in this paper.

23822 Future plans for HEP computing in the U.S. . Ballam, J. (Stanford Linear Accelerator Center, Menlo Park, CA). pp 146-164 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

The computing requirements of the U.S. HEP Community are set forth. These will be dominated in the next five years by the panti p (TEV I) and e^+e^- (SLC and CESR) experiments. The ensuing period will be almost completely driven by the data generated by the superconducting super collider (SSC). Plans for near term computing are presented along with speculations for the SSC. Brief descriptions of accelerator and theoretical physics plans are also presented. (Auth.).

23823 Status of networking for high energy physics in the United States. Kunz, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA). pp 165-172 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

Networks are used extensively for High Energy Physics in the United States. Although the networks have grown in an ad hoc manner with connections typically being made to satisfy the needs of one detector group, they now encompass to large fraction of the U.S. HEP community in one form of another. This paper summarizes the current status and experience with networks. (Auth.).

23824 Fermilab advanced computer program multi-microprocessor project. Nash, T.; Areti, H.; Biel, J.; Case, G.; Cook, A.; Fischler, M.; Gaines, I.; Hance, R.; Husby, D.; Zmuda, T. (Fermilab, Batavia, IL). pp 375-384 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

Fermilab's Advanced Computer Program is constructing a powerful 128 multi-microprocessor system for data analysis in high-energy physics. The system will use commercial 32-bit microprocessors programmed in Fortran-77. Extensive software supports easy migration of user applications from a uniprocessor environment to the multiprocessor and provides sophisticated program development, debugging, and error handling and recovery tools. This

system is designed to be readily copied, providing computing cost effectiveness of below 2200 US dollars per VAX 11/780 equivalent. The low cost, commercial availability, compatibility with off-line analysis programs, and high data bandwidths (up to 160 MByte/sec) make the system an ideal choice for applications to on-line triggers as well as an offline data processor.

23825 **Resume on vector and parallel processing in HEP.** Kunz, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA). pp 385-390 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

HEP computing needs have been dominated by experimentalist's event processing, Monte Carlo generation, and analysis requirements which have become very large with the advent of large 4π detectors. However, HEP needs are no longer completely dictated by the experimentalists, the needs of theory and accelerator design must also be considered. The author outlines the uses to which vector and parallel processing can be put in HEP. (Auth.).

23826 **Status of the development of a parallel-pipelined data driven processor capable of analyzing up to 10^5 events per second on-line.** Church, M.; Gottschalk, E.; Hylton, R.; Knapp, B.; Sippach, W.; Stern, B.; Christian, D.; Guttierez, G.; Holmes, S.; Wehmann, A. (Columbia Univ., New York, NY; Fermi National Accelerator Lab., Batavia, IL). pp 247-251 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

The authors are developing a new approach to the problems of data acquisition and analysis in elementary particle physics. This technique, known as a hardware processor, allows the complete reconstruction of complex events with full precision at rates up to 10^5 events/second. The technique is central to experiments E690 at Fermilab and E766 at Brookhaven National Laboratory which are probing the hadroproduction of strange, charm and bottom particles. (Auth.).

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 23811, 23901

23827 **(DOE/ER/40033—123) Preliminary results from experiment UA6 on inclusive J/psi production in pp interactions at $\sqrt{s}$ = 24.3 GeV.** Malamud, E. (Rockefeller Univ., New York (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 1986. Contract AC02-81ER40033. 7p. (CONF-860977—2). NTIS, PC A02. File Number DE87005904.

From Antiproton '86: European symposium on nucleon-antinucleon interactions; Thessalonika, Greece (1 Sep 1986).

The UA6 detector consists of two arms, each containing a MWPC-magnet spectrometer, a TRD for electron identification, and a finely-segmented electromagnetic calorimeter. J/psi production has been studied using the e^+e^- decay mode. A clean J/psi signal is observed from an analysis of approximately half of our available anti p data. Problems of normalization and comparison with the pp cross section are discussed.

23828 **(IFVE-OEF—85-19) Study of D(1285) -> K/sup +/K/sup -/π/sup 0/ decay and D(1285)- and E(1420)-mesons production in exclusive reactions, induced by π/sup -/- and K/sup -/-mesons at 32.5 GeV/c.** Bitukov, S.I.; Viktorov, V.A.; Golovkin, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701422.

D(1285) and E(1420)-mesons production in charge-exchange reactions induced by π/sup -/ and K/sup -/-mesons at 32.5 GeV/c has been studied. The measured cross sections allowed one to derive limitations for the mixing angle in the axial-vector meson nonet. This means that E(1420)-meson consists mainly of strange quarks. The invariant mass distribution for the kaon pair in D(1285) -> K/sup +/K/sup -/π/sup 0/ decay with statistics by an order of magnitude higher than the available data was obtained. The differential spectrum dN/dmsub(Ksup(+)Ksub(-)) analysis carried out in the delta-dominance model shows that delta(980)-meson cannot be described as a Breit-Wigner resonance with small width. The effective width for delta-meson at the point of $\sqrt{s}$=1 GeV/c/sup 2/ GITAsub(delta) is greater than 180 MeV/c/sup 2/. It points to a strong coupling of delta-meson to hadrons. 12 refs.; 6 figs.

23829 (INIS-mf—10589, pp 20-21) **Regularities found in average charged particle multiplicity in inelastic hadron interactions.** Simak, V.; Vavra, J. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav; Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23830 (INIS-mf—10589, pp 24-25) **Study of nuclear effects using structure functions of heavy nuclei nucleons.** Benvenuti, A.C.; Bollini, D.; Bruni, G. 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23831 (INIS-mf—10589, pp 26-27) **Charm particle production at Serpukhov accelerator.** Novak, M. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23832 (INIS-mf—10589, pp 32-33) **Some characteristics of d-bard and n-barn interactions at 12.2 GeV/c.** 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23833 (INIS-mf—10589, pp 38-39) **Inclusive Δ/sup ++/ production in π/sup -/p interactions at 5 GeV/c.** Sandor, L. (Slovenska Akademia Vied, Kosice, Czechoslovakia. Ustav Experimentalnej Fyziky). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23834 (INIS-mf—10589, pp 56-57) **Diffractive dissociation of neutrons into ΛK/sup 0/ on carbon at 45 GeV.** Prokes, A.; Novak, M.; Hladky, J.; Nemecek, S.; Smizanska, M.; Vecko, M. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23835 (JINR—R-1-85-939) Properties of pC-interactions at Psub(p)=10 GeV/c with the emission of cumulative pions and protons. Armutlijski, D.; Akhababyan, N.; Bartke, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701423.

Submitted to the journal Sov. J. Nucl. Phys. .

About 2000 inelastic pC-interactions at Psub(p)=10 GeV/c with the emission of cumulative pions and protons have been selected and analyzed in the pictures from the 2m propane bubble chamber. The data are obtained both on general characteristics of secondary particles in these events and on interactions with the emission of several cumulative hadrons. Invariant inclusive cross sections of the charged cumulative hadron production including their dependence on the emission angle and the type of cumulative interaction are studied. Besides, leading cumulative hadrons and γ-quanta from the decay of π/sup 0/-mesons emitted to the hemisphere of LSC have been investigated. 8 refs.; 2 figs.; 4 tabs.

23836 (KFK—4128) Measurement of the antiproton magnetic moment and a determination of the LS-term for the antiproton-nucleus-interaction. Kreissl, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Aug 1986. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751340.

The subjects of this thesis are a measurement of the antiproton magnetic moment, a particle property, with the aim of testing the CPT-theorem for the strong interaction and the investigation of a possible spin-orbit-term of the anti p-nucleus-interaction. For both aspects the information is given in the finestructure-splitting of antiprotonic X-ray-transitions from heavy nuclei, since only for those the splitting is observable. From the finestructure-splitting of the transition 11->10 in /sup 208/Pb the magnetic moment of the antiproton can be calculated. The result of this best measurement up to now is μ sub anti p = (-2.8007 +- 0.0091)μ/sub N/. In between the error bars it confirms the CPT-Theorem and the new average value for the difference of the antiproton magnetic moment from the proton magnetic moment is (μ/sub p/-anti μ sub anti p)/average = (-2.5 +- 3).10/sup -3/. At the same time the limits of our detectors are described and other possibilities are discussed. In /sup 174/Yb one observes a splitting of the last observable transition 9->8, which is influenced by the strong interaction. From our measurement we find that the measured splitting is different from the calculated electromagnetic value and the Lorentz-widths of both line components are different as well. It is ΔE/sup sw/ = 58 +- 25 +- 13 eV and $\Delta\Gamma$ = 195 +- 58 +- 20 eV. As result we find a sign for the existence of a spin-orbit-term of the antiproton-nucleus-interaction. Nevertheless is has to be confirmed in further experiments. (orig./HSI).

23837 (LAL—86-11) Search for single photons at PETRA. Behrend, H.J.; Buerger, J.; Criegee, L. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). 1986. 19p. (DESY—86-050). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751064.

A search for single photons, produced in e^+e^- collisions together with particles interacting only weakly with matter, has been performed using the CELLO detector operating at the PETRA storage ring. From the absence of any signal, an upper limit is set at 15(90%CL) on the number of light neutrino species, and lower limits on various supersymmetric particle masses are derived. For massless photinos, mass degenerate scalar partners of the left and right handed electrons are excluded below 37.7 Gev/c^2 (90%CL).

23838 (LBL—22433) Hard photon processes in electron-positron annihilation at 29 GeV. Gold, M.S. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87006248.

The hard photon processes $\mu\mu\gamma$ and hadrons + γ in e^+e^- annihilation at 29 GeV have been studied. The study is based on an integrated luminosity of 226 pb^{-1} taken at PEP with the Mark II detector. For the $\mu\mu\gamma$ process, a small fraction of non-planar events are observed with missing momentum along the beam direction. The resulting missing energy spectrum is consistent with that expected from higher order effects. The observed cross section is consistent with the predicted cross section for this process, σ/sup exp/σ/sup th/ = .90 +- .05 +- .06. The observed hard photon energy spectrum and mass distributions are found to be in agreement with $O(\alpha^3)$ QED. The measured charge asymmetry is in good agreement with the predicted value, A/sub exp/A/sub th/ = .83 +- .25 +- .12. The $\mu\gamma$ invariant mass distribution is used to place a limit on a possible excited muon coupling $G\gamma/M^*$ for excited muon masses in the range $1 < M^* < 21$ GeV of $(G\gamma/M^*)^2 < 10^{-5}$ GeV^{-2} at a 95% confidence level. In the hadrons + γ process, evidence for final state radiation is found in an excess of events over that predicted from initial state radiation alone of 253 +- 54 +- 60 events. Further evidence for final state radiation is found in a large hadronic charge asymmetry A/sub Had+γ/= (-24.6 +- 5.5)%.

23839 (LUIP—8606) Selected results from light ion experiments at the CERN ISR. Otterlund, I. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). Jun 1986. 32p. (LUNFD6/NFFK—7072-1-31(1986)). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750903.

The burning questions is whether the condition necessary for a transition to quark matter can be reached in nucleus-nucleus collisions. The features of dd and /ALPHA-ALPHA/ events observed at the CERN ISR can provide a quideline for estimating the conditions in collisions between heavy nuclei at high energies. Some of these features are reviewed in this talk.

23840 (PCCF-T—85-04) Baryonic decay of the J/psi and gluon spin. Pallin, D. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Apr 1985. 160p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751146.

A study of the J/psi state of the charmomium (c antic state) was performed at the D.C.I. collider in Orsay with the DM2 detector. 9 millions of J/psi have been produced, corresponding to more than one half of the actual world statistics. The very simple mecanism of the e^{+-} annihilation into baryon-antibaryon via the J/psi state, allows measurements of the gluon spin through the emitted baryon angular distribution. The analyse of the channels J/psi $\rightarrow$ p antip and Λ antiA, permits to obtain parameters for the angular distributions. These experimental values favour very clearly a vectorial gluon hypothesis, as postulated by the quantum chromodynamics.

23841 Study of the decay B→psiX. Alam, M.S.; Katayama, N.; Kim, I.J.; Sun, C.R.; Tanikella, V.; Bean, A.; Bobbink, G.J.; Brock, I.; Engler, A.; Ferguson, T.; and others. (State University of New York at Albany, Albany, New York 12222). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3279-3285(1 Dec 1986).

We have measured the inclusive branching ratio for B→psiX to be (1.09 +- 0.16 +- 0.21)%, and the exclusive branching ratios for B^-→psiK^- and B-bar ^{0}→psiK-bar /sup */^{0} to be (0.09 +- 0.05)% and (0.41 +- 0.18)%, respectively. The mass difference between neutral and charged B mesons is 1.1 +- 2.1 MeV, while the difference between the mass of Y(4S) and twice the mean B-meson mass is 18.5 +- 3.0 MeV. The psi momentum distribution implies a substantial two-body decay (in agreement with direct measurements), but also some combination of B→psiX with M/sub X/>1.5 GeV, and B→psi'X.

23842 Search for the S meson in antiproton-proton interactions. Fickinger, W.; Marino, R.; Robinson, D.K.; Ashford, V.; Sakitt, M.; Skelly, J. (Case Western Reserve University, Cleveland, Ohio 44106). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3332-3342(1 Dec 1986).

The interaction between antiprotons and protons has been studied in the range 1910 to 1990 MeV center-of-mass energy in a drift-chamber experiment at the Brookhaven Alternating Gradient Synchrotron. The total cross section has been determined at eleven different incident momenta, and the elastic cross section between 8 and 30 deg in the laboratory has been measured with an energy resolution of about 5 MeV. The cross section for annihilation into charged mesons has also been measured, with the same resolution.

There is no evidence in any of these channels for the existence of a narrow resonance.

23843 **Measurement of sin²theta/sub W/ and rho in deep inelastic neutrino-nucleon scattering.** Reutens, P.G.; Merritt, F.S.; MacFarlane, D.B.; Messner, R.L.; Novikoff, D.B.; Purohit, M.V.; Blair, R.E.; Sciulli, F.J.; Shaevitz, M.H.; Fisk, H.E.; Fukushima, Y. (Univ. of Chicago, IL). *Physics Letters [Section] B;* **152B**: No. 5-6, 404-410(14 Mar 1985). Contract AC02-81ER40033.

The authors describe a high statistics measurement from deep inelastic neutrino-nucleon scattering of the electroweak parameters rho and sin²theta/sub W/, performed in the Fermilab narrow-band neutrino beam. Their measurement uses a radius-dependent cut in y = E/sub H/E/sub ν/ which reduces the systematic error in sin²theta/sub W/, and incorporates electromagnetic and electroweak radiative corrections. In a renormalization scheme where sin²theta/sub W/ identical with 1 - m/sub W/²/m/sub Z/², a value of sin²theta/sub W/ = 0.242 +/- 0.011 +/- 0.005 is obtained fixing rho = 1. If both sin²theta/sub W/ and rho are allowed to vary in a fit to their data, the authors measure rho = 0.991 +/- 0.025 +/- 0.009. 19 references, 3 figures, 2 tables.

23844 **Λ production in e^+e^- annihilation at 29 GeV.** Aihara, H.; Alston-Garnjost, M.A.; Bakken, J.A.; Barbaro-Galtieri, A.; Barnes, A.V.; Barnett, B.A.; Blumenfeld, B.J.; Bross, A.D.; Buchanan, C.D.; Chamberlain, O.; Chien, C.Y. (Lawrence Berkeley Lab., CA). *Physical Review Letters;* **54**: No. 4, 274-277(28 Jan 1985). Contract AC03-76SF00098;AA03-76SF00034;AC02-76ER03330.

The inclusive production cross section of Λ, anti Λ in e^+e^- annihilation at a c.m. energy of 29 GeV has been measured with the time-projection-chamber detector at PEP. The average λ, anti λ multiplicity has been measured to be 0.197 +/- 0.012 (stat.) +/- 0.017 (syst.). Λ-antiΛ pairs have been observed in jets for the first time, and the average number of Λ-antiΛ pairs per event has been measured to be 0.042 +/- 0.017 +/- 0.014. 8 references, 3 figures.

23845 **Search for the supersymmetric partners of the Z^0 and W/sup +/-/.** Adeva, B.; Barber, D.P.; Becker, U.; Berdugo, J.; Boehm, A.; Branson, J.G.; Burger, J.D.; Capell, M.; Cerrada, M.; Chang, C.C.; Chang, Y.H. (III Physikalisches Institut, Aachen, West Germany). *Physical Review Letters;* **53**: No. 19, 1806-1809(5 Nov 1984).

The authors report mass limits on the Z^0 and W/sup +/-/, supersymmetric partners of the Z^0 and W/sup +/-/, respectively, using the MARK-J detector at PETRA. The experimental signatures in both cases are acoplanar lepton pairs with missing energy. For the W/sup +/-/, an additional signature is a single energetic lepton. No evidence is found for either the Z^0 (M/sub Z/$_0$ < 35 GeV) or the W/sup +/-/ (M/sub W/ < 25 GeV). 15 references, 2 figures.

23846 **Multinucleon captures of slow antiprotons in complex nuclei and a search for the H dibaryon.** Condo, G.T.; Bugg, W.M.; Handler, T. (Univ. of Tennessee, Knoxville). *Physics Letters [Section] B;* **144B**: No. 1-2, 27-29(23 Aug 1984). Contract W-7405-ENG-26;AS05-76ER03956.

From a sample of 80,000 antiproton annihilations in complex nuclei, a search has been made for those multinucleon reactions which would result in the production of two units of strangeness. No example of such processes has been found, leading to upper limits for the frequencies of production of final states containing 2Λ, $2K^+$, K^- Λ^0, or the H dibaryon of (1-5) x 10^{-4} per anti p annihilation. 13 references, 1 table.

23847 **Anomalous Z decays and g - 2 of the electron.** Suzuki, M. (Univ. of California, Berkeley). *Physics Letters [Section] B;* **143B**: No. 1-3, 237-240(9 Aug 1984). Contract AC03-76SF00098.

If the leptonic Z decays with an energetic photon are interpreted as cascade decays through a new particle, a stringent constraint is imposed on the couplings by the measured value of the magnetic moment of the electron. In models with a fermion E, where Z → e antiE (e antiE) → electron positron γ, the constraint is avoided if E/sub R/ and E/sub L/ are either both singlets or both members of a doublet. 7 references, 2 figures.

23848 **Experimental search for narrow resonances in the reaction $\pi pp \rightarrow \gamma\gamma n$ at 13 GeV/c.** Chiang, I.H.; Johnson, R.A.; Kwan, B.P.; Kycia, T.F.; Li, K.K.; Littenberg, L.S.; Wijangco, A.R.; Halling, A.M.; Hogan, G.E.; Lu, C.G.; McDonald, K.T. (Brookhaven National Lab., Upton, NY). *Physics Letters [Section] B;* **140B**: No. 1-2, 145-148(31 May 1984).

Using a double arm electromagnetic calorimeter the authors have searched for narrow states produced in the exclusive reaction $\pi^-p \rightarrow \gamma\gamma n$ at 13 GeV/c. No enhancements were observed in the mass range 2.0-4.0 GeV/c². For example, the 90% confidence limit on eta/sub c/ production is $\sigma(\pi^-p \rightarrow$ eta/sub c/n) x B(eta/sub c/ $\rightarrow \gamma\gamma) < 44$ pb. 8 references, 3 figures.

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REFER ALSO TO CITATION(S) 23770, 23930, 23931, 24013, 24041, 24046, 24046, 24047, 24048, 24049

23849 **(BONN-HE—86-05) L=1 mesons and the four-quark condensate in QCD sum rules.** Govaerts, J.; Viron, F. de; Weyers, J.; Reinders, L.J. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Mar 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751195.

We systematically study the L=1 meson spectrum in the context of QCD sum rules for bilinear quark currents of dimension three. We improve the sum rules by including the α/sub s/ corrections correctly and take into account the running of the coupling constant. A correct prediction for the B(1/sup +-/) meson can be obtained provided there is a sizeable departure of the value of the four-quark condensate <0vertical strokeanti qλ/sup a/qanti qλ/sup a/qvertical stroke0> from its factorized value using the vacuum dominance assumption. For the condensates <0vertical strokeanti qγ/sub μ/λ/sup a/qanti qγ/sub μ/λ/sup a/qvertical stroke0> and <0vertical strokeanti qσ/sub μν/λ/sup a/qanti qσ/sub μν/λ/sup a/qvertical stroke0> no such deviation is observed.

23850 **(DESY—86-032) QCD, γγ and heavy quark physics at LEP.** Ali, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751224.

This report gives a brief theoretical overview and summarizes the work done by the members of the Working Group on QCD, γγ and Heavy Quark Physics at LEP.

23851 **(DOE/ER/40200—085) Accurate baryon masses from meson masses using potential models and the 1/D expansion.** Imbo, T.D. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1987. Contract FG05-85ER40200. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006231.

The recently derived ratio of three particle to two particle nonrelativistic binding energies for power law potentials in the leading order of the 1/D expansion, where D is the number of spatial dimensions, is used to investigate the ground state baryon spectrum. Using the phenomenologically successful Martin potential and the known meson masses, it is shown how the above ratio can be utilized to obtain accurate masses for baryons, even those containing light quarks. It is also mentioned how the shifted 1/D expansion may be used to study certain excited baryon states.

23852 **(DOE/ER/40200—086) ZZ production at supercollider energies.** Dicus, D.A.; Wilson, S.L.; Vega, R. (Texas Univ., Austin (USA). Center for Particle Theory). Jan 1987. Contract FG05-85ER40200. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006232.

The invariant mass distribution for pp → ZZ + X is calculated without using the effective W approximation. The exact calculation is found to agree well with the effective W approximation calculation.

23853 (DOE/ER/40200—087) Single W production from heavy Z decay in E_6 theories. Rizzo, T.G. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1987. Contract FG05-85ER40200. 16p. (IS-J—2453). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006233.

We examine the production of single W bosons in the decay of heavy Z bosons, which are present in the low energy limit of E_6 grand unified theories, via the process $Z' \rightarrow W^+l^-$ anti nu/sub l/. The branching ratio for this process is found to be sensitive to the Z'-fermion couplings as well as the amount of mixing between Z' and the usual standard model Z over a wide range of Z' masses.

23854 (DOE/ER/40272--26) New massive stable particles from superstrings and their detection using a time of flight system. Ruiz-Altaba, M.; White, A.P. (Florida Univ., Gainesville (USA). Dept. of Physics). Oct 1986. Contract FG05-86ER40272. 6p. (UFTP—86-26; CONF-8606215—38). NTIS, PC A02. File Number DE87006235.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Prospects for the existence and detection of massive stable particles are considered. We briefly review some previously postulated massive stable candidates and analyze in some detail the possibility that particles containing the new h quark from E_6 be stable, while satisfying cosmological bounds. The experimental requirements for the detection of massive long-lived particles using a time of flight (TOF) system are examined in the context of a Snowmass 1986 "realistic" detector for the SSC.

23855 (EFI—797(24)-85) Inclusive spectra of hadrons in proton-nucleus collisions. Gevorkyan, S.R.; Gulkanyan, G.R.; Kotzinyan, A.M.; Zhamkochyan, V.M. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701413.

A model is proposed, which allows one to describe all exprimental data on inclusive spectra of different hadrons produced on nuclei. The model is based on the following assumptions. After the first inelastic collision with nucleon in the nucleus the proton transforms into some excited system H, which collides with the other nucleons during its passage through the nucleus. Since in inelastic collisions the slow sea partons play the dominant role, the valence quarks of this system H coincide with those of proton. Fragmentation of H into hadrons (as well as into proton) is dilated in the lab system by the Lorentz factor $E/m >> 1$ and so it takes place out of the nucleus. Using the methods of multiple scattering theory one can receive the connection between inclusive spectra on nuclei and those on nucleons. The calculations of inclusive spectra of different hadrons (p, p, πsup(-+), ksup(+-)) were done, and a satisfactory description of the experimental data was obtained. It should be noted that this description was done without introduction of any free parameters. Analogous models are discussed, and their diffference from the method proposed is outlined. 14 refs.; 6 figs.

23856 (EFI—806(33)-85) Peculiarities of the quark-gluon mechanism of the formation of C-even heavy quarkonia in hadron collisions. Egoryan, R.Sh. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701414.

The quark-gluon channel g+q(anti q) -> chisup((J)) +q(anti q) of the formation of C-even states of heavy quarkonia Q anti Q (of chisup((0)), chisup((2)) and chisup((1)) mesons) in hadron collisions is studied. The nonrelativistic character of the Q anti Q-system and the Landau-Yang rules are shown to result in qualitatively different spectra for chisup((0)), chisup((2)) mesons and chisup((1)) meson. Strongly differing from the case of chisup((0.2)) whose spectra in the lowest order of perturbation theory have a polar peculiarity proportionally 1/qsub(perpendicular)sup(2) at transverse momentum qsub(perpendicular) -> 0, the spectrum of chisup((1)) has a logarithmic pole proportionally lnqsub(perpendicular)sup(-2). 3 refs.; 4 figs.

23857 (FNAL/C—86/167) The J/psi trigger-tag for study of weak beauty quark decays at the SSC [Superconducting Super Collider]. Cox, B.; Wagoner, D.E. (Fermi National Accelerator Lab., Batavia, IL (USA); Florida Agricultural and Mechanical Univ., Tallahassee (USA). Dept. of Physics). Dec 1986. Contract AC02-76CH03000. 10p. (CONF-8606215—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006282.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

The weak decays of beauty hadrons offer a unique opportunity at the SSC to study CP violation in a system other than the neutral kaons and provides a long lever arm for searching for new physics if a strategy can be found for triggering on and identifying these decays. We have determined that the decay sequence $B \rightarrow J/psi + X$ followed by the decay of the $J/psi \rightarrow \mu^+\mu^-$ presents an opportunity to both trigger on and to unambiguously distinguish b anti b events from the total cross section events.

23858 (FNAL/Pub—87/19-E) Is there a way to measure the deep-inelastic cross-section using wide-band neutrino beams?. Belusevic, R.; Rein, D. (Fermi National Accelerator Lab., Batavia, IL (USA); Florida Univ., Gainesville (USA); Technische Hochschule Aachen (Germany, F.R.)). Jan 1987. Contract AC02-76CH03000. 15p. NTIS MF A01; 2; GPO Dep. File Number DE87006420.

A method is described for extracting the value of the neutrino flux in a wide-band beam exposure based on computed differential cross-sections for resonance production and quasielastic scattering of neutrinos on nucleons. The resonance production cross-sections, computed by means of a relativistic quark model, are in excellent agreement with measurements of various neutrino-induced exclusive final states performed so far and also with data from inclusive deep-inelastic neutrino interactions. The theoretical uncertainty inherent in the method is estimated to be about 10% and is roughly equal to the systematic error which plagues the measurements of the neutrino flux in present-day narrow-band beams. Before the first Tevatron narrow-band beam data becomes available in a few years time, if at all, this method provides the only reliable way of "measuring" the total neutrino cross-section with the existing wide-band beam data, thus extending the measured energy range by nearly a factor of two.

23859 (IC—86/84) Tensor gluonium spectrum in QCD. Paver, N. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701421.

We examine the 2/sup ++/ gluonium spectrum in the framework of the Gauss-Weierstrass and Finite Energy QCD sum rules. The results of our analysis support the interpretation of the $\theta(1710)$ as a tensor glueball, but they also suggest the existence of at least another state with a mass M> or approx. 2 GeV and a width of about 200 MeV. 14 refs, 8 figs, 2 tabs.

23860 (IC—86/86) On the role of higher twists in describing scaling violation. Chyla, J. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701416.

A method of comparing the QCD predictions for nucleon structure functions scaling violation with deep inelastic scattering data is proposed, the main feature of which being the assumption that the value of Λ/sub QCD/ parameter is known independently of perturbative analyses. We conjecture that a suitable way of determination Λ is through lattice Monte Carlo calculations of quantities like hadronic masses and consider the Λ /sub MS/-bar value thus found around 100 MeV. The method is then used for quantitative analysis of twist 4 contributions, and problems related to higher twist effects determination are discussed. 30 refs, 4 figs, 3 tabs.

23861 **(IC—86/132) Estimate of σ-> axions decay rate.** Dao Vong Duc; Nguyen Thi Hong. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701415.

The σ-> axions decay rate is estimated under some general assumptions in considering the matrix elements of the trace θ/sub μ//sup μ/ of the improved energy-momentum tensor between axion and π - meson states. The approximate relation Γ(σ->αα)/Γ(σ->ππ) — (m/sub α//m/sub π/)/sup 4/ is obtained. 11 refs.

23862 **(IFVE-OTF—85-123) Amplitude of hadron-hadron elastic interaction in a model with σsub(el)/σsub(tot) -> 1 at superhigh energies.** Vall, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701417.

The limiting transition at S -> infinity has been stidied in the hadron elastic scattering amplitude model, based on the exixtence of the multiple vacuum pole in the t-channel decomposition of the generalized reaction matrix. The amplitude within this limit is shown to be an interference sum, whose first term describes absolutely elastic scattering and the other terms describe quantum fluctuations of the hadron simulating drop surface. These fluctuations result in elastic channeling effect. Its interference with the contribution from the first term is a physical reason for dip in the differential cross-section in the model. 14 refs.

23863 **(INIS-mf—10328) Hadrons in two-dimensional quantum chromodynamics: Construction and study of bound states by means of perturbative and non-perturbative methods.** Zeppenfeld, D. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). 27 Jul 1984. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751194.

The present thesis deals with the construction and the analysis of mesonic bound states in SU(N) gauge theories in a two-dimensional space-time. The based field theory can thereby be considered as a simplified version of the QCD, the theory of the strong interactions. After an extensive discussion of the quantization in the temporal gauge and after the Poincare invariance of the theory has been shown mesonic bound states and the meson spectrum for different ranges of the free parameters of the theory (quark mass, coupling constant, and index N of the gauge group) are treated. The spectrum is given by a boundary value problem which in the perturbative limit is solved analytically. For massless quarks gauge-invariant annihilation operators are constructed which permit an exact solution of the energy eigenvalue equation. The energy eigenstates so found described massive interacting mesons which are surrounded by a cloud of massless free particles.

23864 (INIS-mf—10589, pp 34-35) **Effect of localization on proton lifetime.** Dittrich, J.; Exner, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23865 (INIS-mf—10589, pp 42-43) **Production of lambda particles in antineutrino-nucleon collisions and diquarks.** Nogova, A. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23866 (INIS-mf—10589, pp 4-5) **Results of an analysis of Soviet-American experiments on the pion charge radius confirmed at CERN.** Dubnickova, A.Z.; Dubnicka, S. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23867 (INIS-mf—10589, pp 46-47) **New approach in global description of experimental data.** Krupa, D.; Dubnicka, S.; Masiar, P.; Kundrat, V. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav; Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23868 (INIS-mf—10589, pp 6-7) **Effect of long-wavelength approximation on one-photon transition rates calculation for QQ-bar systems.** Adam, J.; Adamova, D. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky; Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23869 (INIS-mf—10589, pp 22-23) **Sum rules in quantum chromodynamics.** Fischer, J.; Kolar, P. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23870 (INIS-mf—10589, pp 28-29) **High energy hadron scattering with small four momentum transfer.** Kundrat, V.; Lokajicek, M.; Krupa, D. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav; Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23871 (INIS-mf—10589, pp 40-41) **Multiplicity moments and KNO distribution density for pp-bar collisions at energy $\sqrt{s}$=540 GeV.** Blazek, M. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23872 (INIS-mf—10589, pp 50-51) **Can an action-at-a-distance theory of quarks be established?.** Weiss, J. (Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Strojnicka Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23873 (INIS-mf—10589, pp 44-45) **Sum rules in hadron physics and quantum mechanics.** Novak, I.; Olejnik, S. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23874 (INIS-SU—378, pp 53-56) **Magnetic mass of gluons in QCD/sub 3/.** Kalashnikov, O.K.; Kasado, Eh. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780101.

Kratkie Soobshcheniya po Fizike.; No. 2.

In Experimental and theoretical physics. Collection.

The nonperturbative infrared limit of gluons polarization operator in calibration nsub(i)Asub(i)=0 at T not equal to 0 is calculated for QCD/sub 3/. The selfconsistent calculations break is ensured by the nonperturbative expression for the three-gluon vertex being the solution of Slavnov-Taylor identities. In the approximation considered the magnetic gluon mass is equal to zero identically.

23875 (INIS-SU—385, pp 17-22) **On the algebraic construction of lepton-quark generations.** Govorkov, A.B. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780104. (N—7-85).

In JINR rapid communications. Collection.

All leptons and quarks are united into a spinor hyperfield constructed over systems, of nonassociative hypercomplex postoctonion numbers. Arising of successive lepton-quark generations is connected with the Cayley-Dickson iterative process for hypernumber systems. Spontaneously broken Gsub(2)xSU(2)sub(L)xU(1) gauge symmetry is formulated and the colour SU(3)sub(c) quark symmetry is explained as the unbroken subgroup of G/sub 2/, the broken automorphism group of postoctonion hypernumbers. The number of generations in this theory should be equal to 2sup(n) (n=0,1,2,...). 5 refs.

23876 (INIS-SU—395, pp 42-49) **Narrow low-mass dibaryons and the possible existence of a new stable baryon.** Abaev, V.V.; Koptev, V.P.; Nikitiu, F. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780088. (N—16-86).

In JINR rapid communications. Collection.

The possible existence of a new stable baryon R(J=1/2, I=3/2, 1025 MeV) and its connection with the narrow low-mass dibaryons are discussed. Proposed is an experiment which can put in evidence the existence of an exotic baryon, R, as well as decide the isospin assignment for low-mass dibaryons (test for I=2 assignment). 13 refs.; 6 figs.

23877 (INIS-SU—398, pp 31-37) **Neutral weak currents in the n+p -> d+e/sup +/+e/sup -/ process.** Rekalo, M.P. 1985. (In Russian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780090.

In Problems of nuclear physics and cosmic rays. No. 23. Republican Interinstitute scientific technical collection.

The general structure of the P-odd differential cross section of neutron-proton collisions, n+p->d+e/sup +/+e/sup -/, has been established. This cross section is caused by the interference of the P-even one photon amplitude which corresponds to be neutral Z-boson exchange. The dependence of P-odd contributions on colliding particle polarizations has been described in terms of structure functions. The P-odd effects with appear in unpolarized particle collisions essentially depend on the np-interaction and disappear in the impulse approximation (at M/sup 2/<=9msub(π)sup(2), M and msub(π) - are the e/sup +/e/sup -/- and pion masses. 11 refs.

23878 (INIS-SU—399, pp 3-5) **Potential model for heavy and light mesons.** Efrosinin, V.P. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780091.

Kratkie Soobshcheniya po Fizike.; No. 4.

In Experimental and theoretical physics. Collection.

Dependence of potential on quark reduced mass is studied for light and heavy mesons (p,π,k/sup +/,kphi,PSI, and γ) with provision for phenomenological regularities. Masses of quark components are calculated. Some results on excited s-states of light mesons are obtained. It is shown that rho'(1250) and rho'(1600) represent the first and the second π-meson excited states. π''(1.6) meson should exist. L(1440) is the eta-meson first excited state. 12 refs.; 1 tab.

23879 (INIS-SU—399, pp 6-8) **Threshold pion production in nucleon-nucleon collisions and extramass behaviour of the s wave πN amplitude.** Efrosinin, V.P.; Osipchuk, I.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780091.

Kratkie Soobshcheniya po Fizike.; No. 4.

In Experimental and theoretical data. Collection.

The model, which describes a behaviour of a s-wave πN-amplitude with one pion beyond the mass-shell, is suggested using in calculations cross sections of p+p -> d+π/sup +/ and p+p -> p+p+π/sup 0/ reactions near by a threshold. The model describes satisfactory p+p -> p+p+π/sup 0/ reaction near by a threshold. To describe threshold production of pions in p+p -> π/sup +/+d reaction it is necessary to take into account small components of a deuteron relativistic wave function. 14 refs.; 2 tabs.

23880 (INP—1202/PH) **Kaon cloud contribution to the magnetic moments of the nucleon octet.** Zenczykowski, P. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701576.

Published in 1983.

Kaon cloud contribution to the magnetic moments of the nucleon octet is evaluated in the framework of the cloudy bag model. Although the kaonic effects are significant, we find only minor deviations from previously calculated values of magnetic moments. In particular the relative values of μ/sub γ//sup -/ and μ/sub Λ/ cannot be explained with the help of the kaon cloud. This feature is expected to hold in any additive (at the "bare" baryon level) and SU(6) symmetric model in which pion and kaon cloud effects can be treated perturbatively.

23881 (JINR—E-2-85-739) **Calculation of the static interquark potential in the string model in the time-like gauge.** Nestevenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701418.

Submitted to the journal Teor. Mat. Fiz. .

Quantum theory of the relativistic string with fixed ends is constructed in the time-like gauge. The gauge conditions are introduced in the reparametrization-invariant action of the string. In the theory there are no tachyon states and constraints on the dimension of space-time. The constraints and gauge conditions are fulfild in quantum theory only as the matrix elements with respect to physical state vectors. The string generates the static interquark potential V(R)=$\sqrt{\gamma}$/sup 2/R/sup 2/+epsilon/sub 0/, where epsilon/sub 0/ is free parameter determined in the experiment. 23 refs.

23882 (JINR—R-2-85-974) **Borel sum rules for the charmonium radiative decays in QCD.** Bejlin, V.A.; Radyushkin, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701419.

Submitted to the journal Yad. Fiz. .

The borelized sum rules are proposed for the 3-point correlators of the currents composed of the c-quarks. On the basis of these sum rules the widths are calculated of the decays J/PSI -> etasub(c)Y, PSI -> eta'sub(c), etasub(c) -> 2Y, eta'sub(c) -> 2y. It is demostrated that the results are rather intensitive to the choice of the c-quark mass parameter. The method is applicable also for the calculation of other radiative decays of the charmonium states. 34 refs.; 6 figs.

23883 (JINR—R-2-86-32) **On the Coulomb gauge for the spinor-spinor quasipotential.** Desmirov, G.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701412.

In the case of two interacting spinor fields with equal masses the first version of the Logunov-Tavkhelidze quasipotential approach is used to construct the quasipotential. The second-order term in the perturbation theory in Coulomb gauge is computer. A Dirac four-component term for the direct and exchange interaction particles is obtained. A two-component Pauli-form for the leading term of the quasipotential is also worked out in nonrelativistic limit for direct interaction the exact structure of the Breit potentials is obtained, without additional terms explicity depending on the energy. For the exchange interaction the same result has been obtained previously using different methods. 11 refs.

23884 **(JINR—R-2-86-101) Electroexcitation of Δ (1230) isobar in the constituent quark model.** Gogilidize, S.A.; Tkebuchava, F.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701411.

Submitted to the journal Sov. J. Nucl. Phys. .

In the framework of the nonrelativistic quark model with hyperfine colourmagnetic interquark forces the electroexcitation of the Δ(1230) isobar is studied. It is shown that the account of a relativistic behaviour of photon-quark interaction and proper consideration of nucleon motion in the Δ-N transition allow one to obtain a satisfactory agreement of calculations with experimental data of photo- and electroexcitation of Δ isobar and proton elastic form factors up to momentum transfers k/sup 2/=-2 GeV/sup 2/. 14 refs.; 2 figs.

23885 (JINR-D—17-84-850-Vol.2, pp 224-235) **Baryon-like and meson-like solitons in a direct coupling quark model in one space dimension.** Ranada, A.F. (Universidad Complutense de Madrid, Spain. Dept. de Fisica Teorica). 1985. NTIS (US Sales Only), PC A16/MF A01. File Number DE87780102. (CONF-8408213—Vol.2).

From 3. international symposium on selected topics in statistical mechanics; Dubna, USSR (22 Aug 1984).

The purpose of the paper is the exposition of the last results of a program of research on nonlinear spinors, aiming at the development of extended elementary particle models, as finite energy solitary waves or eventually solitons, generally called particle-like solutions (PLS). The most characteristic features of this attempt are the systematic use of c-number classical solutions and the description of the forces between the particles by nonlinear direct couplings, without intermediate carriers of any kind. A relativistic and nonrelativistic direct coupling models of quarks in one-space dimension are reviewed. The properties of the field equations, baryon-like and meson-like solutions for it are considered. The main conclusion is that direct coupling quark models offer a very interesting tool, which might provide with an alternative approach to the more popular theories currently accepted. Its development requires the extension to three space dimensions of the theory of solitons, a major goal, with could allow the construction of a coherent theory of extended particles with confined constituents in the future. In that case, the theory of solitons would find a most stimulating application.

23886 **(KFKI—1986-64/A) Inclusive reactions in the quasi-nuclear quark model: numerical results for hadron-hadron collisions.** Kobrinskij, M.N.; Melikhov, D.I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1986. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701420.

The numerical results obtained in the framework of the quasi-nuclear quark model for multiple hadron production processes are summarized and tabulated. A brief summary of notations and of the theory of non-diffractive inelastic baryon-nucleon and meson-nucleon collisions is given. The tables contain the calculated state decomposition coefficients in the cases of different beam hadrons and different tagged quarks. The computer calculated particle spectra for different types of projectile particles are also tabulated. The tables presented can be directly used for evaluation of experimental results. (D.Gy.). 16 refs.; 15 tables.

23887 **(NBI-HE—86-33) Static potential in a string model with extrinsic curvatures.** Olesen, P.; Yang Sungkil. (Niels Bohr Inst., Copenhagen (Denmark)). Aug 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751351.

The static quark potential in a string model including extrinsic curvature effects is studied in the large d limit, where d is the dimensionality of euclidean space. At large distances it is explicitly shown that the physical string tension is dynamically generated. Examining the large-distance "Coulomb" term in the potential, we show that the non-perturbative effects in general generate non-gaussian effective theories in the infrared regime. At large distances the d->∞ saddle point is stable for a large range of parameters.

23888 **(OUP—86-20) Experimental heavy quarkonium physics. Introduction and survey.** Bugge, L. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1986. 127p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750682.

Following some brief arguments on why heavy quarkonium spectroscopy is an important field of particle physics, some points on experimental techniques are discussed. Parts of the basic quarkonium phenomenology, including discussions of various items related to potensial models, are then presented. An up-to-date presentation is given of the state-of-the-art of experimental charmonium and bottomonium spectroscopy below open flavour threshold, including the confrontation of experimental results to representative theoretical predictions. Updated version of lectures presented at the Trondheim 1984 Workshop in theoretical physics. 159 refs.

23889 **(OUP—86-23) ΔI=1/2 rule for K->phiphi decays.** Eeg, J.O. (Oslo Univ. (Norway). Fysisk Inst.). Oct 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750894.

Attempts to explain the ΔI=1/2 rule in K->phi phi decays are discussed. The standard effective Hamiltonian approach to nonleptonic decays is shortly reviewed. Recent long distance approaches, some of which give encouraging results, are described. It is concluded that long distance approaches to the penguin diagram improve the understanding of the ΔI=1/2 rule. 44 refs.

23890 **(SLAC—308) Toponium-Z^0 interference and phenomenology of an extra Z^0 in e^+e^- collisions.** Franzini, P.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006304.

A qualitative discussion of toponium-Z^0 interference is followed by a brief discussion of heavy quark potentials and the spectrum of toponium states which results. The results of the toponium spectra and the mixing formalism are then used to find the cross sections and asymmetries for toponium near the Z. The phenomenology of two-Higgs models and the bounds imposed on them by their effects on neutral B meson mixing are discussed, followed by the effects an extra Higgs doublet may have on toponium-Z^0 interference. The topic then turns to phenomenology of an extra Z^0 in electron-positron collisions. Models under consideration are reviewed, and the existing limits on such models are considered. What can be learned by electron-positron annihilation measurements at the Z peak without polarized beams is discussed, as well as further restrictions that can be made with polarized beams. The potential for experiments in the energy region above the Z is discussed. 57 refs. (LEW)

23891 **(SLAC-PUB—4165) Small multiplicity events in $e^+ + e^- \rightarrow Z^0$ and unconventional phenomena.** Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1986. Contract AC03-76SF00515. 21p. (CONF-870390—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006777.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Events with two-, four- or six-charged particles and no photons produced through the process $e^+ + e^- \rightarrow Z^0$ provide an opportunity to search for unconventional phenomena at the SLC and LEP electron-positron colliders. Examples of unconventional proc-

esses are compared with the expected background from electromagnetic processes and from charged lepton pair production.

23892 **(UWThPh—1986-33) Decay π/sup 0/ -> e/sup +/e/sup -/ and two-photon processes.** Neufeld, H.; Pietschmann, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701603.

Motivated by the discrepancy between theoretical predictions and present experimental data for the branching ratio of π/sup 0/ -> e/sup +/e/sup -/ we propose a measurement of the electromagnetic pion form factor through the two-photon process e/sup +/e/sup -/ -> e/sup +/e/sup -/π/sup 0/.

23893 **(UWThPh—1986-37) Progress in our notion of mass.** Pietschmann, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701605.

The development of our concepts of quantum field theory especially in the version of local gauge theories has brought about a tremendous success in predicting and explaining experimental facts. As a side-effect, our understanding of the notion of mass has undergone dramatic changes. Since this is not accompanied by a change in experimental predictions or empirical notions, it is progress in a field which might be considered on the borderline of physics and philosophy of nature.

23894 **(UWThPh—1986-44) Leptonic and hadronic decay rates of winos.** Kizukuri Yoshiki; Oshimo Noriyuki. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701610.

We show that, in wide classes of supergravity models, the ratio of the leptonic and hadronic decay widths of winos is very different from that of heavy leptons which decay via the standard weak interaction. For example, it becomes 20% in one case and 70% in another case, while it will be 36% in case of heavy leptons. The production of wino pairs in next e/sup +/e/sup -/ experiments will be tested by the ratio of leptonic and hadronic final states.

23895 **Explicit formulae for heavy flavour production.** Ellis, R.K.; Sexton, J.C. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Physics [Section] B;* **282**: No. 3/4, 642-652(2 Mar 1987).

Explicit formulae are given in QCD for the processes which contribute to the hadroproduction of heavy quarks Q. The processes considered are (1) q + anti q -> Q + anti Q, (2) g + g -> Q + anti Q, (3) Q + anti Q -> q + anti q + g, (4) Q + anti Q -> g + g + g. All mass effects are included. A comparison of the exact matrix elements with the results of the leading pole and soft gluon approximation is made.

23896 **Classical dynamics of strings with rigidity.** Curtright, T.L.; Ghandour, G.I.; Zachos, C.K. (Department of Physics, University of Florida, Gainesville, Florida 32611). *Physical Review [Section] D: Particles and Fields;* **34**: No. 12, 3811-3823(15 Dec 1986).

We explore the classical dynamics of strings with rigidity, i.e., with terms added to the string action which depend on the extrinsic curvature of the world sheet. We study classical solutions of the string equations of motion using both analytical and numerical methods, and we determine the leading Regge trajectories $J(E^2)$ for a set of classical rotating string configurations. We observe that for open strings the dominant classical solutions are identical to those for the conventional Nambu string, and correspondingly give linear trajectories. However, for closed strings we find new solutions that include finite-energy, static configurations, and that give trajectories which are nonlinear as the lowest-energy solution is approached, but become linear asymptotically as $J(E^2)\rightarrow\infty$.

23897 **Perturbative QCD analysis of exclusive pair production of higher-generation nucleons.** Ji, C.; Sill, A.F. (Department of Physics, Stanford University and Stanford Linear Accelerator Center, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3350-3353(1 Dec 1986). Contract AC03-76SF00515.

Results are presented of a perturbative QCD analysis of heavy-baryon form factors to leading order in α/sub s/ including all higher-twist quark-mass effects. A dip in the total cross section for the e^+e^- pair production of some higher-generation nucleons is predicted. The results are consistent with the definition of charge form factors at zero momentum transfer and reproduce the well-known anomalous magnetic moments of nucleons. These considerations resolve a sign ambiguity in previous leading-twist analyses of the hard-scattering contribution to the proton magnetic form factor.

23898 **Hyperphoton production in W-boson decay.** Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3519-3520(1 Dec 1986). Contract W-7405-ENG-82.

We calculate the rate and energy distribution for hyperphoton (γ') production in W-boson decay via the process $W\rightarrow u+\bar{s}+\gamma'$. We show that the width for this decay mode is $\simeq$0.36 MeV and that the signal for such decays: two jets plus missing energy ($\simeq$20 GeV): is quite distinct.

23899 **Inelastic photoproduction of charged vector bosons.** Dicus, D.A.; Kallianpur, K.J. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3533-3535(1 Dec 1986).

A proposal for a photon beam at the Superconducting Super Collider makes Mikaelian's paper on photoproduction of charged vector bosons of current interest. We update that paper to include modern values of the parameters, modern distribution functions, and an electric quadrupole coupling in the three-gauge-boson vertex. The cross section remains large enough that a substantial number of W/sup +- / could be produced. The prospects for determining the three-gauge-boson coupling, however, are not good.

23900 **E^+e^- peaks at 1.8 MeV: Phenomenological constraints on nuclear transitions, axions, and the particle interpretation.** Krauss, L.M.; Zeller, M. (Department of Physics, Yale University, New Haven, Connecticut 06511). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3385-3393(1 Dec 1986).

We investigate phenomenological constraints on a variety of possible explanations of the e^+e^- peaks observed by the EPOS Collaboration at GSI. We first review problems with a variety of proposed nuclear-related production mechanisms. Next we investigate constraints on the axion interpretation of the observed events. New non-accelerator-related constraints come from considerations of shifts in the hyperfine splitting in positronium, and an analysis of the decays $K\rightarrow\pi e^+e^-$ and $\pi\rightarrow e^+e^-e^+\nu$, which are relevant for a proposed short-lived axion variant. We then demonstrate that present and past beam-dump experiments are, in a model-independent way, sensitive to a new 1.8-MeV particle coupling to electrons. Our estimates suggest that if the particle does not interact in the target one should see very high event rates for all allowed lifetimes from 10/sup -14/—10/sup -10/ sec at high-energy facilities and lifetimes greater than 10/sup -10/ sec at low-energy dumps.

23901 **On muon decay in left-right-symmetric electroweak models.** Herczeg, P. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3449-3456(1 Dec 1986).

We investigate the implications of a recent measurement of the positron-momentum-spectrum end point in polarized muon decay for general SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models.

23902 **Modifications in neutrino counting due to additional gauge bosons.** Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3516-3518(1 Dec 1986). Contract W-7405-ENG-82.

We examine the possible influence of additional heavy neutral gauge bosons (Z_1^0) on attempts at neutrino counting in e^+e^- annihilation below the Z_1^0 (≅93 GeV) resonance. A large class of two-Z^0-boson models is examined. We find that the apparent shift in the number of neutrinos, N/sub ν/, due to the extra Z^0 boson in these models is never larger than ≅0.4 if N/sub ν/ = 3 and somewhat smaller if N/sub ν/ = 4. Thus we should not expect a large "error" in neutrino counting to result in these extensions of the standard model.

23903 **Ma responds.** Ma, E. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Physical Review Letters;* **57**: No. 22, 2871-2871(1 Dec 1986).

The coupling of the Z boson is considered in terms of a postulated quark model. (AIP)

23904 **Systematic study of large CP violations in decays of neutral b-flavored mesons.** Du, D.; Dunietz, I.; Wu, D. (Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3414-3427(1 Dec 1986).

CP-violation effects in partial-decay-rate asymmetries of B/sub d/^{0} and B/sub s/^{0} systems are examined within the framework of the Kobayashi-Maskawa model. We concentrate on those hadronic final states into which both B^0 and B-bar ^{0} can decay. The rephasing-invariant formalism is used in our calculation. We find a quite large asymmetry (—0.6) in some decay modes, such as B/sub d/^{0}→$D^+\pi^-$, B/sub s/^{0}→$D^+\pi^-$, D^0phi, etc., but we still need 10^6—10^7 bb-bar pairs for testing these effects for 3σ signature. In addition, the contribution of the penguin diagrams and the problem of strong-interaction phases of final states are also briefly discussed. We find that for testing CP violations with only the penguin contribution the best decays are B/sub d/^{0}→phiK/sub S/, B/sub s/^{0}→phiK/sub S/, which need, for 3σ signature, 3 x 10^8 bb-bar pairs.

23905 **Searching for possible large CP-violation effects in neutral-charm-meson decays.** Du, D. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3428-3433(1 Dec 1986).

Possible large CP-violation effects in the partial-decay-rate asymmetries for the D^0-D-bar ^{0} system are discussed. All possible nonleptonic two-body final states are studied. It turns out that D^0→π^-K^+, π^0K^0, π^0eta, $\pi^0\omega$, K^+K^-, phiK^0 are the most promising channels. If the D^0-D-bar ^{0} mixing is on —1% level, 10^4—10^6 D^0D-bar ^{0} pairs would be enough for testing these channels.

23906 **Explicit mass formulas for heavy mesons and baryons.** Pagnamenta, A.; Sukhatme, U. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3528-3529(1 Dec 1986).

Applying the recently developed shifted large-N expansion technique to the Schroedinger equation with the Martin power-law interquark potential, we obtain simple mass formulas for mesonic and baryonic states composed of heavy quarks (s,c,b,. . .).

23907 **Exact calculation of ff→ffWW for the charged-current sector and comparison with the effective-W approximation.** Gunion, J.F.; Kalinowski, J.; Tofighi-Niaki, A. (Department of Physics, University of California, Davis, Davis California 95616). *Physical Review Letters;* **57**: No. 19, 2351-2354(10 Nov 1986).

We have computed the complete set of amplitudes for fermion + fermion into fermion + fermion + $W^+ + W^-$ for all possible fermion types. We use these results to analyze the phenomenology of the WW scattering sector and to compare to the effective-W approximation.

23908 **Production of glueballs.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY). *Comments on Nuclear and Particle Physics;* **13**: No. 6, 285-311(1984). Contract AC02-76CH00016;AC02-83ER40107.

This Comment discusses the evidence for production of glueball states. The BNL CCNY g/sub T/ (2120), g/sub T/ (2220), and g/sub T/ (2360) produced in the reaction $\pi^- p \rightarrow$ phi phi n are shown to be produced by 1-3 glueballs if (1) QCD is correct, and (2) the OZI (or Zweig) rule is universal. Other glueball candidates such as the iota (1440) and Theta (1640) are discussed. 39 references, 16 figures.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 24163, 24169, 24170

23909 **(IC—86/153) On the exceptional Lie algebras E/sub 6/ and E/sub 8/.** Nguyen van Hieu; Nguyen Hung Son. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701522.

The exceptional Lie algebras E/sub 6/ and E/sub 8/ are realized in terms of the operators transformed covariantly under the subalgebra SO(10). The commutation relations are given explicitly. 3 refs.

23910 **(IC—86/189) Multiplets of Verma modules over the osp(2,2)/sup (1)/ super Kac-Moody algebra.** Dobrev, V.K. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701534.

The reducible Verma modules over the super Kac-Moody algebra osp(2,2)/sup (1)/ are studied. The Verma modules with unitarizable integral highest weights and those with singular weights (that is with central charge equal to minus the dual coxeter number) are completely classified and parametrized. The idea to extend the Weyl-Kac group as proposed earlier for affine Lie algebras and finite-dimensional superalgebras is discussed. 22 refs.

23911 **(NBI-HE—86-29) N=2 superconformal invariance in two-dimensional quantum field theories.** Yu Ming; Zheng Haibin. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751349.

We construct N=2 superconformal current and vertex operators using chiral superfields. Then we present a derivation of the N=2 superconformal dimensions of the degenerate representations by generalizing Thorn's method and Feigin and Fuchs' construction of Dotsenko and Fateev. Finally, unitary representations of the N=2 algebra in the twisted sector are constructed out of free fermions. (orig./HSI).

23912 **(NBI-HE—86-34) N=2 superconformal theories.** Petersen, J.L. (Niels Bohr Inst., Copenhagen (Denmark)). 1986. 14p. (CONF-8606226—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751350.

From Symposium on topological and geometrical methods in field theory; Espoo, Finland (8 Jun 1986).

In this talk I shall describe recent results obtained by our group in Copenhagen on degenerate and unitary representations of the N=2 algebra. (orig./HSI).

23913 **(UWThPh—1986-39) Supersymmetric quantum mechanics defined as sesquilinear forms.** Pittner, L.; Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701606.

A formulation of supersymmetric quantum mechanics in terms of sesquilinear forms is presented. Otherwise occurring rather complicated domain questions are solved in a simple and natural way. We formulate the axioms and describe a number of models. Supersymmetry transformations are implemented as superunitary transformations in a space defined over a Grassmann algebra; gen-

eralized Bogoliubov transformations acting in that space are formulated too.

6454 Field Theory

REFER ALSO TO CITATION(S) 23769, 23773, 23869, 23889, 23901, 23902, 24168

23914 (CONF-860766—2) Supermanifolds and super Riemann surfaces. Rabin, J.M. (Chicago Univ., IL (USA)). Sep 1986. Contract AC02-82ER40073. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004578.

From Nato advanced research workshop on super field theories; Vancouver, Canada (25 Jul 1986).

The theory of super Riemann surfaces is rigorously developed using Rogers' theory of supermanifolds. The global structures of super Teichmueller space and super moduli space are determined. The super modular group is shown to be precisely the ordinary modular group. Super moduli space is shown to be the gauge-fixing slice for the fermionic string path integral.

23915 (DOE/ER/40272—23) Strings in spring (86). Ramond, P. (Florida Univ., Gainesville (USA). Dept. of Physics). 15 May 1986. Contract FG05-86ER40272. 25p. (UFTP—86-23; CONF-8605182—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005677.

From 7. Vanderbilt high energy physics conference; Nashville, TN, USA (15 May 1986).

We present an overview of recent progress in string theory. We treat in detail the mechanics of some of the Calabi-Yau compactification and summarize some of its experimental consequences.

23916 (IC—86/262) Conformally covariant coupled non-linear field theory on the hypercone: Vacuum solutions and quantization of normal modes. Aciktepe, T.; Akdeniz, K.G.; Barut, A.O.; Kalayci, J. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701557.

For the conformally covariant coupled non-linear spinor-scalar fields of the σ-model type we show that the non-trivial vacuum instanton solutions have a geometric meaning as constant spinors on the five-dimensional hypercone. The quantized fields around these solutions correspond to the normal modes of the hypercone. A connection is thus established between field theory, particle spectrum of the fields and quantized excitations of a geometry (the hypercone). 10 refs.

23917 (INIS-mf—10330) Boson-fermion duality in four dimensions: Comments on the paper by Luther and Schotte. Garbaczewsky, P. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)). Sep 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751187.

BiBoS.; No. 98.

Fock space for the fermion field can be identified with this for the boson field, provided the overall numbers of internal degrees of freedom are the same. As a consequence the respective free field Hamiltonian systems are equivalent (dual): the four component neutrino model is thus equivalent to the doublet of independent ('electric' and 'magnetic' respectively) Maxwell fields which are quantized in the manifest Coulomb gauge. This statement arises on the continuum field theory level and seems to falsify the claim that realistic photons can be constructed from (bound) pairs of neutrinos. The more correct claim in this framework is that each (anti)neutrino degree of freedom represents and is represented by the photon type ('electric' and 'magnetic' respectively) degree of freedom. By repeating the classic Weinberg's construction we can rewrite the common for both models Hamiltonian in two equivalent ways: in terms of a relativistic spin 1/2, m=0 field or in terms of the spin 1, m=0 doublet of four-potentials. One of them is the standard Maxwell ('electric') potential while the other has all symmetry properties of the dual ('magnetic') one.

23918 (INIS-SU—401, pp 33-36) Two-point correlation functions in stochastic nonholonomic quantum field theory. Zubko, A.V.; Maliev, I.N. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

Introduction of nonholonomic gauge conditions results in nontransversality of polarization operator. It's consequences are discussed. It is shown that double correlator of intensities of the gauge field is not gauge invariant as in standard quantum theory.

23919 (LA-UR—87-634) Towards an analytic solution of QCD: The glueball mass gap. West, G.B. (Los Alamos National Lab., NM (USA)). Jan 1987. Contract W-7405-ENG-36. 16p. (CONF-870151—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006061.

From Irvine conference on non-perturbative methods in field theory; Laguna Beach, CA, USA (7 Jan 1987).

Certain general features and beliefs concerning quantum chromodynamics are reviewed with he view to seeing whether the theory sense and whether its physical spectrum can be determined. A typical Green's function is represented as an expansion around the minima of the action, each term of which is divergent and requires renormalization. It is shown that even after renormalization, each of the series generated by expansion around a minimum is divergent and requires a summability procedure to make sense. The causality and analyticity of the resulting Green's function is then discussed. The ideas thus developed are shown to determine the position of the first singularity of the Green's function. (LEW)

23920 (LBL—22796) Old physics, new physics and colliders. Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). 14 Jan 1987. Contract AC03-76SF00098. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006249.

Some topics in the standard model of strong and electroweak interactions are discussed, pointing out some problems in this model and indicating how these problems are attacked in some theoretical models. A discussion of radiative corrections in the Glashow-Weinberg-Salam model is given that stresses how these corrections may be measured at LEP and the SLC. Some features of QCD are discussed which are relevant to hadron colliders. In discussing the unsolved problems of the standard model, some aspects of models in which quarks and leptons are composite particles are considered. 85 refs., 44 figs. (LEW)

23921 (NBI-HE—86-12) Appearance of critical dimensions in regulated string theories. Pt. 2. Ambjoern, J.; Durhuus, B.; Froehlich, J. (Niels Bohr Inst., Copenhagen (Denmark)). Apr 1986. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751239.

We supply numerical evidence for the existence of critical dimensions dsub(c/sub 1/) and dsub(c/sub 2/) in a gaussian model of a discretized string, between which the mean number of vertices in the world sheet diverges, and hence a continuum limit may exist. We also discuss the possibility of non-trivial continuum limits. In particular, by introducing an additional parameter into the model, we argue that non-trivial continuum limits can possibly be obtained only between two critical dimensions d/sub 0/' and d/sub 0/. Furthermore, we give proofs of some lower bounds on determinants of combinatorial Laplacians entering the models, which were announced in a previous paper.

23922 (NBI-HE—86-14) Non-perturbative study of regularized bosonic string amplitudes. Orland, P. (Niels Bohr Inst., Copenhagen (Denmark)). Apr 1986. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751238.

The Wick-rotated, light-cone gauge U(N) Veneziano model of open and closed strings is examined in the limit as N->∞, with g/sup 0//sub 2/N fixed. The amplitudes in both the "Pomeron sector" (whose graphs are cylinders with holes punched out) and the "Reggeon sector" (whose graphs are rectangles with holes punched out) are regularized using the lattice method of Giles and Thorn, as well as an alternative method. It is not possible to obtain Lorentz covariance as the cut-off is removed, unless g/sup 0//sub 2/N is taken to zero. When this is done, the Pomeron and Reggeon

sector spectra are those of the free closed and open strings, respectively. The possible implications for superstrings as well as for large N gauge theories are briefly discussed.

23923 **(NBI-HE—86-28) Random dynamics.** Bennett, D.L.; Brene, N.; Nielsen, H.B. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1986. 27p. (CONF-8606233—3). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751352.

From 2. nobel symposium on elementary particle physics; Marstrand, Sweden (2 Jun 1986).

The goal of random dynamics is the derivation of the laws of nature as we know them (standard model) from inessential assumptions. The inessential assumptions made here are expressed as sets of general models at extremely high energies: gauge glass and spacetime foam. Both sets of models lead tentatively to the standard model.

23924 **(NORDITA—85/30-Prepr.) Mesons in the Eguchi Kawai model.** Haan, O. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Sep 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751241.

Fermions in the fundamental representation of the SU(N) gauge group are incorporated into the Eguchi Kawai reduction scheme. The proof for the equivalence of reduced and extended theories is given. This equivalence can be used, to calculate chiral condensate and meson propagators from the fermion matrix of a partially reduced TEK model.

23925 **(SLAC-PUB—4168) Superstring spectroscopy.** Peskin, M.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1986. Contract AC03-76SF00515. 22p. (CONF-860736—9). NTIS, PC A02. File Number DE87005931.

From SLAC summer institute on particle physics; Stanford, CA, USA (29 Jul 1986).

The basic elements of string theory are presented after a brief review of the main properties of string theories, particularly the supersymmetric version. Lessons are provided on the basic quantized string, zero-point energy, the bosonic string, compactification on a torus, the superstring, the heterotic string, field compactification on an orbifold, and string compactification on an orbifold. 35 refs., 17 figs. (LEW)

23926 **(UWThPh—1986-30) Connections on Clifford bundles and the Dirac operator.** Blau, M. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701601.

It is shown, how - in the setting of Clifford bundles - the spin connection (or Dirac operator) may be obtained by averaging the Levi-Civita connection (or Kaehler-Dirac operator) over the finite group generated by an orthonormal frame of the base-manifold. The familiar covariance of the Dirac equation under a simultaneous transformation of spinors and matrix-representations emerges very naturally in this scheme, which can also be applied when the manifold does not possess a spin-structure.

23927 **(UWThPh—1986-32) Stochastic quantization of gauge, gravitational and string fields.** Rumpf, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701602.

The stochastic quantization method of Parisi and Wu and its application to gauge fields are briefly reviewed. The method is then generalized so as to make it applicable to Einstein gravity. The generalization is based on the existence of a preferred metric in field configuration space and involves Ito's calculus. In the nonlinear case the indefiniteness of the Euclidean Einstein action necessitates to generalize the stochastic formalism further to Lorentzian spacetimes. The formalism is shown to imply the path integral measure of De Witt, a causal Feynman propagator, and a consistent stochastic perturbation theory. Finally it is shown how stochastic quantization resolves the indefiniteness problem in free bosonic string field theory.

23928 **(UWThPh—1986-34) Fractional charges in external field problems and the inverse scattering method.** Grosse, H.; Opelt, G. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701604.

Motivated by recent studies of the quantization of fermions interacting with external soliton fields, we construct all reflectionless potentials for the one-dimensional Dirac operator, which are solitons of coupled MKdV equations. The charge of the fermion field in presence of these solitons varies continuously. For the N-soliton solutions it becomes the sum of the charges of the individual problems. The questions of unitary equivalence of representations of the CAR as well as the implementability of gauge transformations are studied for specific examples.

23929 **Monopoles in topologically massive gauge theories.** Pisarski, R.D. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **34**: No. 12, 3851-3857(15 Dec 1986).

In the presence of a Chern-Simons term, a single Dirac monopole induces a current that extends throughout space-time. The Dirac string acquires a constant charge per unit length, which should confine monopoles and antimonopoles by a linear potential. The monopole of 't Hooft and Polyakov is generalized to include a Chern-Simons term for the gauge field, and the string tension for these monopoles is calculated.

23930 **Solving momentum-space integral equations for quarkonia spectra with confining potentials.** Eyre, D.; Vary, J.P. (Theoretical Physics Division, National Research Institute for Mathematical Sciences of the Council of Scientific and Industrial Research, P.O. Box 395, Pretoria 0001, Republic of South Africa). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3467-3471(1 Dec 1986).

Singular integral equations for quarkonia (qq-bar) spectra are solved in momentum space for different choices of confining potentials by introducing a regularization procedure. The method is sufficiently general to treat nonlocal potentials and combinations of singular potentials. Through nonrelativistic model applications we demonstrate the stability and accuracy of the method. The method works in all partial waves. A first-order correction to the eigenenergies brings calculated results for soluble model problems into remarkable agreement with exact results. Extensions of the method to solve the nonrelativistic spectra of three-quark systems and to solve the relativistic Bethe-Salpeter equation are discussed.

23931 **Scaling of the 0sup++ glueball mass in SU(N) Hamiltonian lattice calculations.** Chin, S.A.; Long, C.; Robson, D. (Department of Physics, Texas A&M University, College Station, Texas 77840). *Physical Review Letters;* **57**: No. 22, 2779-2782(1 Dec 1986).

We show that a variational calculation of the ground-state energy of SU(N) Hamiltonian lattice gauge theories concurrently gives an estimate of the 0/sup ++/ glueball mass. Monte Carlo calculations in three spatial dimension for $N = 3, 4, 5$, and 6 indicate that the resulting glueball mass begins to scale for $N \geq 5$.

23932 **Two-phase model and the Johnson vacuum in one dimension.** Zahed, I.; Klabucar, D. (Massachusetts Institute of Technology, Cambridge). *Physical Review [Section] D: Particles and Fields;* **30**: No. 12, 2647-2652(15 Dec 1984). Contract AC02-76ER03069.

The authors discuss the relevant vacuum fluctuations in a two-phase model of the light baryons, in one dimension. It is shown that the limiting procedure in which the quark phase is shrunk to zero size is problematic within a naive chiral bag formulation. To circumvent these difficulties, a cutoff-dependent chiral bag model is constructed, using Johnson's description of the vacuum state in two-dimensional QCD. The resulting picture is shown to interpolate continuously between bagged QCD_2 and a sine-Gordon model. Pertinent conclusions for three dimensions are sketched. 8 references, 5 figures.

23933 **Geometry and physics of Wess-Zumino supergravity.** Xizeng Wu. (Massachusetts Institute of Technology, Cambridge). *Physical Review [Section] D: Particles and Fields;* 30: No. 12, 2462-2473(15 Dec 1984). Contract AC02-76ER03069.

It is shown that the Kaehler manifold of Wess-Zumino supergravity is the noncompact coset space SU(N,1)/[SU(N) x U(1)] and the Kaehler metric is an Einstein metric. The mass sum rule turns out to be the same as that in global supersymmetry. This mass sum rule makes it possible to have supersymmetry (SUSY)-breaking and vanishing scalar potential. Effective theories with or without the grand-unified-theory (GUT) sector are derived from the Wess-Zumino supergravity. They do not have scalar mass terms and trilinear terms among the soft SUSY-breaking terms. Their relevance to the gravitino mass problem is suggested. In a simple SU(5) SUSY GUT model they also show how the scalar partners of quarks and leptons and gauginos get their masses radiatively. The stability problem of the gauge hierarchy is also discussed. 21 references, 12 figures.

65 PHYSICS II

23934 **(INP—1278) List of publications of workers of the Institute of Nuclear Physics in Cracow. 1955-1980.** Babecki, J.; Bednarz, W.; Kuszaj, K.; Ptak, K.; Zrodlewska, K. (Institute of Nuclear Physics, Krakow (Poland)). 1985. 741p. (In Polish). (IFJ—1278). NTIS (US Sales Only), PC A99/MF A01. File Number DE87701424.

Bibliography contains 3500 publications of 294 workers of the Institute of Nuclear Physics in Cracow published during the first 25 years of its activity. The publications are presented in alphabetic order. Personal author index is enclosed. (A.S.).

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 23368, 23820, 23830, 24032

23935 (INIS-mf—10589, pp 12-13) **Study of production and properties of neutrons in nucleus-nucleus collisions at energies up to 5 GeV/nucleon.** Dolejsi, J.; Trka, Z.; Trkova, J.; Grishin, V.G. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni; Vysoka Skola Chemicko-Technologicka, Prague, Czechoslovakia; Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23936 (INIS-mf—10589, pp 36-37) **Azimuthal correlations in central collisions of relativistic nuclei.** Karabova, M.; Siles, E.; Vokal, S.; Sumbera, M.; Tucek, J. (Univerzita P.J. Safarika, Kosice, Czechoslovakia. Prirodovedecka Fakulta; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23937 (INIS-SU—392, pp 580) **Determination of model-less characteristics of nuclear excited states by method of the angular correlation functions for the exit particles and γ-quanta.** Zelenskaya, N.S.; Teplov, I.B. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23938 **(ITEF—59(1985)) Measurement of total inelastic cross sections of proton and π/sup +/-meson interaction with nuclei in the momentum range from 1.35 to 3.75 GeV/c.** Gachurin, V.V.; Druzhinin, B.L.; Ezhov, B.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701437.

Total cross sections of inelastic proton and π/sup +/-meson interactions with sup(6, 7)Li, /sup 9/Be, /sup 12/C, /sup 27/Al, /sup 65/Zn, /sup 181/Ta, /sup 207/Pb, /sup 209/Bi, /sup 238/U nuclei in the 1.35-3.75 GeV/c momentum range of incident particles are measured. Measurements were carried out with targets of different thickness. The results are tabulated and presented as diagrams. Absolute error of measurements makes up +-4%, relative one is +-2%. No irregularities in the energy dependence of cross section either on light or on heavy nuclei are observed within the limit of accuracy of conducted measurements. Cross section of nucleus interaction with a proton is approximately 10% larger than that of nucleus ifteraction with a pion. Measured cross sections are approximately 5% lower than those obtained by other authors under similar conditions. 7 refs.; 4 figs.; 2 tabs.

23939 **(UCID—18987-87) Report to the DOE Nuclear Data Committee 1987.** Lanier, R.G.; White, R.G. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 15p. NTIS, PC A02. File Number DE87006601.

Both measurements and calculations in the field of nuclear data applications are reported. New measurements include the discovery of two new Lr isotopes, the energy-level structure of Mo-93, a probe of the shell crossing at A = 40 via beta decay (experiment and theory), proton and neutron transition densities in Li-6 and Li-7 from a comparative study of proton and neutron scattering at 24 MeV, measurement of the neutron induced fission cross section of Cm-242, quadrupole moments and spectroscopy of Po-210 with Bi-209(t,2n) reaction, excitation functions for Y-89 + p over the range 5 to 40 MeV, excitation functions for Y-89 + d over the range 3 to 40 MeV, and the nuclear structure of Th-231. New calculations reported include the gamma ray cascades in the code ALICE, low energy neutron capture of neutron rich target nuclides, exploratory (n,f) cross section calculations for the U-235 1/2+ isomer, calculated photon induced isomer production in Lu-176 and its impact on the use of Lu-176 as a stellar chronometer and/or thermometer, disagreement between measured capture gamma ray spectra and calculations, electromagnetic moments for Sr-88 and Sr-86, shell model calculations of first forbidden beta decay in the mass 40 region, and dipole strength function studies in the actinide mass region. 8 refs., 7 figs., 2 tabs. (DWL)

6511 Experimental Techniques

23940 (IA—1421, pp 111) **Time of flight system for polarization measurement of photoneutrons from the /sup 2/H(γ,n) reaction.** Wolf, A.; Berant, Z.; Birenbaum, Y.; Kahane, S.; Moreh, R. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

23941 **(OUP—83-15) Fast ADC scanner for multiparameter nuclear physics experiments.** Midttun, G.; Ingebretsen, F.; Holt, K.; Skaali, B. (Oslo Univ. (Norway). Fysisk Inst.). Apr 1983. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750898.

A fast readout system for multiparameter experiments in nuclear physics is described. The central part of the CAMAC aquisition hardware is an ADC scanner module. The scanner incorporates a new arbitration logic and direct memory access for simultaneous transfer of singles and correlated data. Together with specially designed ADC interfaces the system can be set up for any configuration of singles and multiparameter events from 1 up to 15 ADC's in one crate.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

23942 (INIS-mf—10589, pp 87-88) **Analysis of energy dependence of polarization factors in the framework of R-matrix theory.** Kozma, P.; Bem, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23943 (INIS-mf—10589, pp 91) **Charge asymmetry in d+d reactions.** Bem, P.; Kozma, P.; Presperin, V.; Vincour, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23944 (INIS-mf—10589, pp 92-93) **Proton polarization in /sup 2/H(d,p-vector)/sup 3/H and /sup 12/C(d,p-vector/sub 0/)/sup 13/C reactions at low energies.** Bem, P.; Kozma, P.; Presperin, V.; Vincour, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23945 **(JINR—E-1-86-78) Peculiarities of deuteron production in /sup 4/He-proton interactions.** Glagolev, V.V.; Lebedev, R.M.; Pestova, G.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701439.

Submitted to the journal Acta Phys. Slovaca.

Some features of fast deuteron production have been studied in /sup 4/He nucleus-proton collisions at 8.6 GeV/c. The experiment has been carried out by means of a 1 m hydrogen bubble chamber at the JINR. The /sup 4/Hep -> ddp and /sup 4/Hep -> dppn reactions are compared with one another and also with the results obtained from the Monte Carlo procedure based on a double scattering model. The comparison shows that a great bulk of non-spectator deuterons is formed by the coalescence mechanism via the final state ineraction. The coalescence process is of a random nature apd depends mainly on the proton and neutron relative momenta. 11 refs.

23946 **(KFK—4158) Investigations of nuclear projectile break-up reactions. A laboratory approach of nuclear astrophysics.** Rebel, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Oct 1986. 51p. (CONF-8609219—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751232.

From Brasov international summer school: symmetrics and semiclassical features of nuclear dynamics; Poiana Brasov, Romania (1 Sep 1986).

The cross sections for radiative capture of α-particles, deuterons and protons by light nuclei at very low relative energies are of particular importance for the understanding of the nucleosynthesis of chemical elements and for determining the relative elemental abundances in stellar burning processes at various astrophysical sites. As example we quote the reactions α+d -> /sup 6/Li+γ, α+/sup 3/He -> /sup 7/Be+γ, or α+/sup 12/C -> /sup 16/O+γ. As an alternative to the direct experimental study of these processes we consider the inverse process, the photodisintegration, by means of the virtual photons provided by a nuclear Coulomb field: Z+a -> Z+b+c. The radiative capture process b+c -> a+γ is related to the inverse process, the photodisintegration γ+a -> b+c by the detailed balance theorem. Except for the extreme case very close to the threshold the phase space favours the photodisintegration cross section as compared to the radiative capture. The Coulomb dissociation cross section proves to be enhanced due to the large virtual photon number, seen by the passing projectile, and the kinematics of the process leads to particular advantages for studies of the interaction of the two break-up fragments at small relative energies E/sub bc/. The conditions of dedicated experimental investigations are discussed and demonstrated by recent experimental and theoretical studies of the break-up of 156 MeV /sup 6/Li projectiles. In addition, a brief review about general features of break-up processes of light ions in the field of atomic nuclei is given.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

23947 **(INIS-mf—10343) Search for the two-photon decay of the 2/sup +/ first excited states in /sup 18/O and /sup 28/Si.** Music, M. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). Jan 1986. 93p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87751321.

The present work describes an attempt to measure the probability for the two-photon transition between two adjacent nuclear states in the presence of an allowed, strongly predominant one-photon decay, using the Heidelberg-Darmstadt Crystal Ball Spectrometer. The branching ratios of the two-photon decay of the first excited, 2/sup +/ levels of /sup 18/O and /sup 28/Si relative to the one-photon, E2 transitions to the 0/sup +/ ground states were determined to be: Wγγ/Wγ = (0.7 +- 2.4) x 10/sup -6/ for the 2/sup +/>0/sup +/ transition in /sup 18/O and Wγγ/Wγ = (1.6 +- 1.8) x 10/sup -6/ for the 2/sup +/>0/sup +/ transition in /sup 28/Si. Since both results are consistent with zero, it is possible to express them as the upper limits for the two-photon decay (3 δ) of 7.9 x 10/sup -6/ of /sup 18/O and 6.9 x 10/sup -6/ of /sup 28/Si 2/sup +/ levels. These values are by far the smallest ones reported to be observed in a two-photon decay of a nuclear state. For /sup 18/O, the result disproves theoretical estimates of the corresponding two-photon E1F1 matrix element was well as experimental values deduced from multiple-Coulomb-excitation measurements. The main experimental difficulties were caused by the gamma rays from one-photon transitions and were found to be connected with cross-talk events due to bremsstrahlung of Compton electrons and not - as generally believed - positron annihilation in flight.

23948 **(INIS-mf—10353) Studies on the light heavy ion system /sup 6/Li+/sup 16/O.** Glasner, K. (Bochum Univ. (Germany, F.R.). Fakultaet fuer Physik und Astronomie). 6 Jun 1984. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751311.

In the present thesis the system /sup 6/Li+/sup 16/O is studied in the range of the Coulomb threshold. The measured excitation functions exhibit almost without exception correlatedly occurring structures at E/sub lab/=5.4 MeV respectively 6.5 MeV (this corresponds to E/sub x/(/sup 22/Na)=18.5 MeV respectively 19.3 MeV). A detailed statistical analysis consisting of the calculation of the fluctuation band widths in the sense of the Ericson theory, the peak-counting analysis, the Fourier analysis, the auto-/cross-correlation analysis, as well as the calculation of the energy-dependent cross correlation and deviation functions identifies these phenomena as resonances (99% confidence limit). Further structures at E/sub lab/=4.7 and 7.8 MeV (corresponds toE/sub x/=17.9 respectively 20.2 MeV) reach the 90% confidence level. The mean coherence width resulted to Γ ≅ 130 keV and lies by this distinctly below the experimentally determined resonance widths of 350 keV ≦Γ/sub tot/≦800 keV. The positions of the resonances can be well described by the assumption of a K=1 rotational band in the nucleus /sup 22/Na. Beside the model-dependent spin assignment the distribution of the angular momenta in the entrance channel suggests a negative parity of the band. By means of the experimentally determined linear cross correlation coefficients for isobaric analogue decay channels furthermore the Coulomb matrix element is determined to <H/sub x/>=1.5 keV. The comparison with the mean level width of the compound nucleus /sup 22/Na at excitation energies around 19 MeV indicates an extremely low Isospin violation. (orig./HSI).

23949 (INIS-SU—392, pp 321) **Total cross sections of alpha particle interaction with beryllium and carbon nuclei.** Dubar, L.V.; Eleukenov, D.Sh.; Nemets, O.F.; Slyusarenko, L.I.; Tokarevskij, V.V.; Yurkuts, N.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23950 (INIS-SU—392, pp 351) **Search for contribution of quadrupole excitations in the cross section of α-particle electroproduction on /sup 9/Be and /sup 12/C nuclei.** Likhachev, V.P.; Buki, A.Yu.; Evseev, I.G. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23951 **(JINR—R-15-85-775) /sup 10/Be(p,n) reaction at < 2 MeV proton energy. A possible ultrasensitive method for /sup 10/Be determination.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701440.

Cross section (σ) of the /sup 10/Be(p,n) reaction has been measured in the 800-2000 keV energy range of protons. The experiments were performed on the beam of electrostatical Van der Graaf generator. The maximum value σ approximately equal to 260 mb was observed at Esub(lab)=1050 keV, near the threshold of the /sup 10/Be(p,n)/sup 10/B* reaction (1/sup +/ level, E=718 keV). The mean cross section value in the Esub(lab)=1030-1400 keV energy interval was estimated to be antiσ approximately equal to 180 mb. Sensitivity limit of the /sup 10/Be-determination by the (p,n) reaction was evaluated as approximately 10/sup 7/ atoms or approximately 10sup(-11) atom per atom of /sup 9/Be. 20 refs.; 3 figs.; 1 tab.

23952 **(LA—10941-T) Inelastic pion scattering by ^{13}C at low energies.** Mitchell, J.H. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87006168.

Angular distributions for inelastically scattered pions were obtained for several states in ^{13}C at an incident energy of 65 MeV. The data include results from both π^+ and π^- measurements. In addition, π^- measurements were made at T/sub π/ = 50 MeV at one angle to give a two point fixed-q excitation function. The data are compared to theory and the data of others. As might be expected, medium corrections are shown to be considerably more important at low energies than at resonance. This is true for inelastic transitions of multipolarity 0,2 and 3. Parameters derived from an analysis of elastic pion scattering and SCX data also provide an adequate description of the inelastic transitions. The charge asymmetry in the cross sections for the $9/2^+$ state that was seen at resonance persists at these energies. This result is consistent with an impulse approximation treatment of the spin-flip amplitude. This is true even though the incoming energy of the pions is far below the range where the validity of an impulse treatment is expected. 65 refs., 45 figs.

23953 **Reaction ^{6}Li(e,e/sup '/d) ^{4}He and the α-d momentum distribution in the ground state of ^{6}Li.** Ent, R.; Blok, H.P.; van Hienen, J.F.A.; van der Steenhoven, G.; van den Brand, J.F.J.; den Herder, J.W.A.; Jans, E.; Keizer, P.H.M.; Lapikas, L.; Quint, E.N.M.; and others. (Natuurkundig Laboratorium, Vrije Universiteit, 1007 MC Amsterdam, The Netherlands). *Physical Review Letters;* **57**: No. 19, 2367-2370(10 Nov 1986).

The α-d momentum distribution in the ground state of ^{6}Li has been measured in parallel kinematics with the reaction ^{6}Li(e,e'd) ^{4}He in the momentum range 0<p/sub m/<270 MeV/c. The reaction can be described by a direct coupling of the virtual photon to a deuteron in ^{6}Li. The results agree well with the predictions of a three-body αNN model of ^{6}Li.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

23954 **(INIS-mf—10326) Systematic study of the deuteron scattering on even-even sd-shell nuclei by means of the particle-gamma angular correlation at E/sub d/=10 MeV.** Ortner, H.W. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 17 May 1984. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751312.

At the Erlangen tandem accelerator the differential cross sections and the particle-γ-angular corrections for the deuteron scattering to the 1st excited state on the nuclei /sup 20,22/Ne and /sup 32,34/Se were measured. The analysis of the data was performed by distorted-wave-Born-approximation (DWBA) and coupled-channel (CC) calculations in the framework of extended optical models. A special aim was thereby layed on the optical potential necessary for the description of the data and the kind of the model. The d-γ angular correlation was thereby proved as valuable tool for the fit of the real and imaginary part of the optical potential. the symmetric DWBA (equal potentials in the entrance and exit channel) yielded only for the nuclei with relatively small quadrupole deformation (/sup 32/S,/sup 34/S) a sufficient description. For more deformed nuclei the DWBA couldn't under application of credible potentials reproduce especially the angular correlation data. A much more consistent description of the data in the highly deformed nuclei yielded CC calculations with optical potentials which were for all nuclei very similar. (orig./HSI).

23955 (INIS-mf—10589, pp 100-101) **Measurement of EC/β/sup +/ ratio in light nuclei decay.** Sykora, I.; Povinec, P. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23956 **Spin-spin potentials in /sup 27/Al/sub pol/+n/sub pol/ and the nuclear Ramsauer effect.** Gould, C.R.; Haase, D.G.; Seagondollar, L.W.; Soderstrum, J.P.; Nash, K.E.; Schneider, M.B.; Roberson, N.R. (North Carolina State University, Raleigh, North Carolina 27695 and Triangle Universities Nuclear Laboratory, Duke Station, Durham, North Carolina 27706). *Physical Review Letters;* **57**: No. 19, 2371-2374(10 Nov 1986).

Spin-spin effects in neutron-nucleus interactions have been studied with a polarized /sup 27/Al target and polarized neutrons of energies 5 to 17 MeV. Because of nuclear Ramsauer interference, real and imaginary spin-spin terms in the optical potential give rise to energy dependences of spin-spin effects which are out of phase. We find a central real potential V/sub SS/ = 750 +- 440 keV, consistent with folding-model calculations, and a central-volume imaginary potential W/sub SS/ = -780 +- 320 keV, related to compound-nuclear absorption effects.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

23957 **(INDC(CPR)—010/L) Gamma ray production cross sections for the interactions of 14.9 MeV neutrons with C, Al, V, Fe and Nb at 90 deg. .** Zhou Hongyu; Tang Lin; Yan Yiming. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701563.

Discrete γ-ray spectra and production cross sections for the interactions of 14.9 MeV neutrons with C, Al, V, Fe and Nb targets have been measured at 90 deg. using a 110.7cm/sup 3/ Ge(Li) detector. A single γ-ray peak was measured for C. For Al 34 γ lines, for Fe 41 γ lines, for V 61 γ lines and for Nb 79 γ lines were measured. 25 refs, 13 figs.

23958 (INIS-mf—10327) Scattering of polarized neutrons on argon and study of the complex spin-orbit potential. Schneidereit, U. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet I - Mathematik und Physik). 10 Feb 1985. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751193.

At the Erlangen scattering facility for polarized neutrons measurements on liquid argon were performed at 11 and 13.5 MeV. Thereby the experimental arrangement of the facility was extended to 23 detectors. The amplification of each detector is stabilized by high-voltage post-regulation. In the measurement of liquid argon a thin-walled aluminium dewar was applied the filling quantity of which was kept constant by a filling facility. The background from this dewar amounts only 9% of the argon counting rate. The analysis of the data (analyzing power, differential cross sections, and σ/sub tot/) showed that the application of an imaginary spin-orbit potential in the framework of the optical model improves essentially the description of the measurement. A study of the geometries of the spin-orbit potential led to smaller values of the diffuseness proportional to 0.5 fm than proposed by global parameter sets. For the radius of the imaginary term of the spin-orbit potential the analysis yielded a value proportional to 1.38 fm which lies considerably above the real spin-orbit radius. The quantity of the imaginary spin-orbit diffuseness tends to smaller values than 0.5 fm. Comparative calculations with neutron data on /sup 40/C a allow a common description of both nuclei and contain also in the result an imaginary spin-orbit potential. From the calculations the isospin-dependent parts of the potentials could be estimated. From the analysis of the first excited state of /sup 40/Ar the values of the coupling constants of the quadrupole deformation could be determined to 0.23 +- 0.02. The measured total cross sections agree well with other measurements.

23959 (INIS-mf—10344) Fusion with polarized heavy ions. Particle evaporation and fission at energies at and below the barrier. Butsch, R. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751324.

With the polarized /sup 23/Na beam available at the Max-Planck-Institute for Nuclear Physics in Heidelberg the fusion reactions /sup 23/Na+/sup 48/Ti and /sup 23/Na+/sup 206/Pb at energies at and below the barrier were studied in order to obtain information about the dynamics of the fusion process at low energies. With the alignment of the nuclear spin of the /sup 23/Na ions (symmetry axis = beam axis) beside the fusion cross section a further independent measurement quantity, the tensor analyzing power for fusion, is obtained. For the system /sup 23/Na+/sup 48/Ti the evaporation residual nuclei were detected by the time-of-flight method, while in the systems /sup 23/Na+/sup 206/Pb the fission fragments were identified by the ΔE-E method. In both systems the fusion cross section is described by the evaporation-residual-nucleus cross section respectively the fission cross section. The measured excitation functions of the cross section and the tensor analyzing power for fusion of both systems were analyzed regarding the coupling to nuclear excited states. For this the used model, in which the fusion cross section is approximated as difference of the reaction and the inelastic cross section, had to be extended to aligned projectiles with spin. (orig./HSI).

23960 (INIS-mf—10345) Study of peripheral heavy ion reactions at 84 MeV/nucleon. Rabe, H.J. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751323.

In peripheral heavy ion reactions between /sup 18/O and /sup 58,64/Ni, /sup 18/O and /sup u97/Au, as well as between /sup 12/C and /sup 197/Au at an incident energy of 84 MeV/nucleon azimutal angular correlations between projectile fragments and light particles (p,d,t,α) were studied. By the selection of heavy projectile fragments Z/sub p/$\geqq$6 and small multiplicity of the light particles from the target or from the reaction zone peripheral reactions between the heavy ions were selected. The data analysis showed that the emission of light particles under ΔPHI=180/sup 0/, i.e. on the side lying relative to the beam axis opposite to the projectile fragment, is distinctly increased. The counting-rate ratio N(ΔPHI=180/sup 0/)/N(ΔPHI=0/sup 0/) can amount up to 3.5:1. A detailed analysis yields the result that the anisotropy is closely correlated to the transverse momentum p/sub t/ of the projectile fragments, whereby the connection for p/sub t/ 600 MeV/c is nearly linear. The absolute cross section for these processes with small multiplicity of the light particles in coincidence with heavy projectile fragments (Z/sub p/$\geqq$6) lies in the order of magnitude of 200 mb. (orig./HSI).

23961 (INIS-SU—392, pp 341) Determination of spin of deep-lying proton-hole states in the /sup 58/Ni(d,/sup 3/He)/sup 57/Co reaction. Vagner, G.; Bekhtol'd, V.; Grabmair, P.; Zigert, G.; Kiva, V.; Kim, T.; Mairle, G.; Pugach, V.; Fridrikh, L. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23962 (JINR—R-1-86-117) Emission of fast deuterons at the proton interactions with emulsion heavy nuclei. Bannik, B.P.; Bobodzhanov, I.; Bogdanov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701441.

A relative yield of deuterons with momenta of approximately (0.23-0.45) GeV/c per nucleon has been measured at the interaction of 4.5 GeV/c protons with Ag, Br emulsion heavy nuclei. Similar data obtained for 24 GeV/c proton momentum at other laboratories are analyzed. From the comparison of the experimental results it follows that at an incident particle momentum of 24 GeV/c cascade nucleons are not the only reason of deuteron emission; some mechanism not yet studied makes a significant contribution. 21 refs.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

23963 (DOE/ER/40293—1) Nuclear structure studies via neutron interactions: Progress report, July 1, 1986-June 30, 1987. Carlton, R.F. (Middle Tennessee State Univ., Murfreesboro (USA). Dept. of Chemistry and Physics). Mar 1987. Contract FG05-86ER40293. 28p. NTIS, PC A03. File Number DE87006368.

The research performed during the reporting period consisted of: (1) the analysis of total cross section data for the isotopes of: ^{48}Ca up to a neutron energy of 4 MeV; /sup 122,124/Sn up to 200 and 300 keV, respectively; and ^{189}Os up to 170 eV; (3) the preliminary interpretation of these results in the framework of the optical model in an effort to extend the systematics of the potentials deduced from resonance and non-resonance information obtainable from ORELA neutron cross section data; and (4) the interpretation and publication of nuclear structure results for $_{48}$Ca, and the osmium isotopes and their implications for the use of the Re/Os chronometer in estimating the age of the universe. Continued evidence for the l-dependence of the real well depth of the optical model for neutron elastic scattering from selected target nuclei is seen. Finally, a system for rapid analysis of total neutron cross section data has been developed for microcomputer application which includes the capability for spin and parity assessment for individual resonances and plotting of individual partial wave contributions to the total cross section. This should significantly enhance the study of nuclear structure via neutron interaction. 10 refs., 8 figs., 7 tabs.

23964 (INIS-mf—10342) Studies of nuclear high-spin levels in the mass range around Z $\simeq$90 and Z $\simeq$150. Sanchez Cordova, H.A. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751320.

The aim of this thesis was the study of high-spin states in medium heavy nuclei around Z $\simeq$40 and heavy nuclei around Z $\simeq$90 by means of γ-spectroscopy. The experiments were performed

at the Heidelberg tandem accelerator Emperor of the MPI for nuclear physics. By means of the reaction /sup 58/Ni(/sup 32/S,xyz) for the first time a level scheme for /sup 87/Nb is proposed. By means of the same reaction the Yrast line in /sup 84/Zr is studied. Furthermore the β/sup +/ decay of /sup 87/Nb was studied via the γ-radiation following the β decay. The beta strength distribution exhibits a strong structurization contrarily to assumptions yet always used in applications. By application of a double anti-Compton spectrometer by means of the reaction /sup 122/Sn(/sup 35/Cl,xyz) the yrast line of /sup 153/Ho was studied. Spins up to I=89/2 h were observed. This spin belongs to the highest hitherto observed spins of discrete nuclear levels. The level scheme of /sup 153/Ho could by this be studied far in the range of the M1 quasi-continuum.

23965 (INIS-SU—392, pp 339) **Spectra of charged particles produced in the 24.6 MeV α-particle interactions with /sup 61/Ni and /sup 63/Cu nuclei.** Smirnov, A.V.; Antropov, A.E.; Osorio, V.F.; Zarubin, P.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23966 **(OUP—83-16) Study of the angular distribution of the secondary particles of anti pAg/Br reactions at 1.4 GeV/c incident momentum observed in photographic emulsion.** Breivik, F.O.; Jacobsen, T.; Soerensen, S.O. (Oslo Univ. (Norway). Fysisk Inst.). Apr 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750899.

Some features of anti pAg/Br reactions at 1.4 GeV/c incident momentum are studied by means of the emulsion technique. The distributions of the number of charged particles/event are presented. The angular distributions indicate som anisotropic process in the nuclear matter, possibly shock waves, and some back-to-back emission.

23967 **(OUP—83-44) Anisotropic and correlated emissions of short range charged particles in anti pAg/Br reactions of 1.4 GeV/c incident momentum observed in photographic emulsions.** Breivik, F.O.; Jacobsen, T.; Soerensen, S.O. (Oslo Univ. (Norway). Fysisk Inst.). Dec 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750900.

Anti pAg/Br reactions at 1.4 GeV/c incident momentum were studied by means of the emulsion technique. A group of short range charged particles was observed. For the events with one short track, a backward and transversal emission was seen, probably due to some very fast process. For the events with two short tracks, a back-to-back emission was seen, indicating some two-body decay where the target nucleus possibly behaves spectator-like. The rates and forward collimations suggest that the same physical process causes the different multiplicities.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

23968 **(INIS-mf—10341) Study of the fission dynamics of hot atomic nuclei by means of the neutron emission.** Zank, W.P. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 15 Jan 1986. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87751319.

In the framework of the present thesis fusion processes with subsequent fission are studied in the heavy ion reactions /sup 141/Pr+/sup 40/Ar and /sup 175/Lu+/sup 12/C. The aim of the studies is the determination of the hitherto not precisely known lifetimes of excited composite systems before these separate into two fission fragments. In order to study such effects the reactions /sup 141/Pr+/sup 40/Ar at 316 MeV argon as well as /sup 175/Lu+/sup 12/C at 192 MeV carbon projectile energy were measured. The evaluation of the measured angular distribution of the fission fragments and the evaporation residual nuclei yielded the angular momentum ranges which lead to the fusion with subsequent fission respectively to evaporation residual nuclei. A large critical angular momentum of 109 +- Planck constant in the reaction Pr+Ar and an essentially smaller value of 62 +- 6 Planck constant for the system Lu+C result regarding the uncomplete fusion. The analysis of the neutron emission measured in coincidence with fission fragments allowed the determination of the neutron multiplicities for the composite system before the scission as well as for each single fission fragment. Large multiplicities before the scission of 3.6 +- 0.6 and 6.3 +- 0.8 in the reactions Pr+Ar and Lu+C were observed. In the study of the pre-equilibrium neutron emission in the incompletely fusioning system Lu+C for the first time a strong concentration of the emitted neutrons in the plane defined by the direction of flight of the fission fragments and the ion beam was shown. This anisotropy can be interpreted as anisotrope neutron emission relative to the angular momentum direction of the composite system. A corresponding anisotropy was not observed for the neutron evaporation from the completely equilibrated system. (orig./HSI).

23969 (INIS-mf—10589, pp 123-124) **/sup 95/Mo(n,α) and /sup 143/Nd(n,α) reactions with 3 MeV neutrons.** Szarka, I.; Florek, M.; Oravec, J.; Holy, K.; Helfer, H. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta; Technische Univ., Dresden, German Democratic Republic. Sektion Physik). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23970 (INIS-SU—392, pp 93) **Multipole mixing in the 2/sub 3//sup +/-2/sub 1//sup +/ of /sup 114/Cd.** Araddad, S.Yu.; Rateb, D.M.; Zlitni, S.; Demidov, A.M.; Kurkin, V.A.; Zhuravlev, O.K. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

23971 **33 and 43 MeV (^{3}He, xnγ) exclusive reactions on targets from Zr to Pb.** Fields, C.A.; De Boer, F.W.N.; Ristinen, R.A.; Smith, P.A.; Sugarbaker, E. (Univ. of Colorado, Boulder). *Nuclear Physics [Section] A;* **A429**: 259-268(1984). Contract AC02-81ER40016.

Exclusive neutron spectra for neutron multiplicities x = 3, 4 and 5 have been obtained using the 33 and 43 MeV (^{3}He, xnγ) reactions on targets of Zr, Pd, Sn, Nd, Pt, Au, and Pb. The exclusive spectral shapes vary systematically with the energy available for neutron decay in the initial or precompound nucleus. The (^{3}He, xnγ) reaction differs from the (α, xnγ) reaction at the same beam energy per nucleon in its dependence on available energy, target, and incident angular momentum. 15 references, 5 figures, 2 tables.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

23972 **(INIS-mf—10338) Nuclear structure studies on /sup 178/Hf by means of neutron induced gamma and electron spectroscopy.** Al Mamun Imtiazul Haque. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 2 Feb 1985. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751314.

By means of thermal and epithermal neutron captures the nucleus /sup 178/Hf was studied. With high-resolution spectrometers the gamma transitions and conversion electrons were measured. By the found energies, intensities, and multipolarities the level scheme of /sup 178/Hf could be essentially improved and extended. Totally 270 secondary (from 600 gamma lines) and 39 primary gamma transitions were used in order to establish the level scheme with 66 levels in 18 rotational bands. For this 92% of all gamma intensities were used. Several new rotational bands were established. By improved gamma energies the level scheme below 2 MeV for spins between 0 and 6 is well confirmed. Moreover by the resolution of several multiplets the decay structure of the levels could be explained. The thermal neutron capture state results from the primary gamma transitions to Q/sub n/=7626.34 (23) keV.

Electrical monopole transitions from several states were studied in order to determine the X(E0/E2) values. (orig./HSI).

23973 (INIS-mf—10589, pp 58-59) **Nuclear orientation of /sup 160/Tb in diamagnetic matrix.** Finger, M.; Sedlak, B.; Englich, J.; Rotter, M.; Dupak, J. (Joint Inst. for Nuclear Research, Dubna, USSR; Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni; Ceskoslovenska Akademie Ved, Brno. Ustav Pristrovoje Techniky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23974 (INIS-mf—10589, pp 79-80) **Investigation of /sup 169/Yb->/sup 169/Tm decay by means of an anti-Compton spectrometer.** Adam, J.; Honusek, M.; Kracik, B.; Wagner, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23975 (INIS-mf—10589, pp 119-120) **Electric quadrupole interaction in /sup 157/Dv-Gd system.** Prochazka, I.; Lebedev, N.A.; Pavlov, V.N ; inger, M.; Simecek, P.; Ehn, L.; Yushkevich, Yu.V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23976 (INIS-SU—385, pp 32-38) **On the /sup 158/Tb decay: impossibility of neutrino balance.** Brudanin, V.B.; Brianson, Sh.; Valen, R. (Joint Inst. for Nuclear Research, Dubna, USSR; TsYaSMS, Orsay,, France). 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780104. (N—7-85).

In JINR rapid communications. Collection.

With the help of semiconductor detectors a more precise determination of the energies of /sup 158/Gd and /sup 158/Dy excited states populated in the decay of /sup 158/Tb has been made. By the use of Xγt-coincidence method the absence of an ultralow-energy K capture branch to the state at 1187 keV (/sup 158/Gd) was shown. That excludes the possibility of neutrino balance in this decay. This conclusion was confirmed by the analysis of the probabilities of the K capture to the states at 1023 and 1041 keV, which gives the value of Q=1212Λ-/sub 8//sup +10/ keV for the mass difference of /sup 158/Tb-/sup 158/Gd (where Q is a decay energy). 12 refs.; 3 figs.; 2 tabs.

23977 **(JINR—R-6-85-792) /sup 158/Tb decay and possibility of more precise determination of electron neutrino mass.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701438.

Submitted to the journal Bull. Acad. Sci. USSR, Phys. Ser. .

The measurements of the single γ-quantum and γγt-coincidence spectra in the /sup 158/Tb decay the results of which allowed the decay scheme's more precise determination have been made. From the analysis of the electron capture relative probabilities to the 1023.7 and 1041.6 keV levels the value of the mass difference of /sup 158/Tb-/sup 158/Gd, Q=1218sub(-11)sup(+15)keV, indicating the energy forbidding of K-capture to the 1187.1 keV level of /sup 158/Gd has been determined. This conclusion was confirmed by high-precision KXγt-coincidence measurements, which have shown that the relative probability of K-capture to the state at 1187.1 keV in the /sup 158/Tb decay was <2.5 x 10sup(-5)Psub(K)sup(1023) on the 90% confidence level. On the base of the available data the conclusion is made about unperspectivity of /sup 158/Tb decay studying with the purpose of electron neutrino mass precise measurement. 23 refs.; 9 figs.; 4 tabs.

23978 **(JINR—R-6-85-813) Lifetimes of sup(171)Yb excited states.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701442.

Lifetimes of 7/2/sup -/7/2[514] 835 keV (Tsub(1/2)<0.31 ns) and 9/2/sup +/, 7/2[633] 167 keV (Tsub(1/2)<0.46 ns) excited states sup(171)Yb have been measured by the delayed coincidence method in three-dimensional analysis mode. Within the quasiparticle-phonon modeltaking into account the Pauli principle the energies, structures of nonrotational states of sup(171)Yb and reduced probabilities of electric dipole E1 - and quadrupole E2 - transitions are calculated. 15 refs.; 2 tabs.; 2 figs.

23979 **(OUP—83-24) Decay from the two-quasiparticle regime in even-even deformed rare earth nuclei.** Henriques, A.; Thorstensen, T.F.; Hammaren, E. (Oslo Univ. (Norway). Fysisk Inst.). Jun 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750911.

A bump at 1 MeV has been identified in coincidence gamma-ray spectra from the (/sup 3/He,/sup 4/He) reaction in deformed rare earth nuclei. Particle/gamma-ray angular correlation indicates a dipole character. It is suggested that this bump corresponds to transitions from two-quasiparticle states to the ground state band.

23980 **^{152,154}Eu(t,α) reactions: studies of the 11/2[505] bands in ^{151}Sm and ^{153}Sm.** Martz, H.E.; Lanier, R.G.; Struble, G.L.; Mann, L.G.; Sheline, R.K.; Stoeffl, W. (Lawrence Livermore National Lab., CA). *Nuclear Physics [Section] A;* A439: 299-316(1985). Contract W-7405-ENG-48.

Radioactive targets of ^{153}Eu(13 y) and ^{154}Eu(8.5 y) have been used to study the ^{152,154}Eu(t, α)^{151,153}Sm reactions at an incident triton energy of 16 MeV. In these studies, the authors have identified the bandhead and three excited rotational states of the 11/2[505] neutron orbital in both the ^{151,153}Sm nuclei. The angular distributions and relative intensities for states in this band in both ^{151,153}Sm are reproduced reasonably well by using. DWBA calculations and by assuming strongly deformed single-particle wave functions. The authors have used our results and the results of other studies to determine the equilibrium prolate shapes of both ^{151,153}Sm when the odd-neutron quasiparticle occupies the 11/2[505] orbital. The authors estimate $\beta_2 \sim 0.26$ for ^{151}Sm and $\beta_2 \sim 0.3$ for ^{153}Sm. 33 references. 6 figures, 6 tables.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

23981 **(CEA-CONF—8552) Coincidence measurements on Ar+AU at 23.8 MeV/u.** Tomasi, E.; Charvet, J.L.; Bassini, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). Aug 1986. 2p. (CONF-860802—12-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751065.

From International nuclear physics conference; Harrogate, UK (25 Aug 1986).

Published in summary form only.

23982 (INIS-mf—10589, pp 75-76) **Internal pair production in nuclear alpha decay.** Stanicek, J.; Povinec, P. (Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

23983 (IA—1421, pp 112) **Photofission of /sup 238/U with neutron-capture gamma rays.** Kahane, S.; Wolf, A. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

23984 **(IKMz—86-1) Institute for Nuclear Chemistry, University of Mainz. Annual report 1985.** Weber, M. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). 15 Aug 1986. 64p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87751317.

The report summarizes work on: Transport behaviour of fission products in gas jet systems; thermochromatography of lanthanides; combination of a gas jet system with an inductively coupled plasma ion source; modification of the SISAK II system for the separation of short-lived reaction products; installation of a gas jet system at the mass separator LOHENGRIN. Half-lives of neutron-rich Ru- and Rh-isotopes; levels in /sup 114,116/Ag after β/sup -/- decay of /sup 114,116/Pd; collective states in /sup 230/Ra; structure of /sup 227/Ra; proton-unbounded states in /sup 22/Mg and /sup 26/Si; study of the reaction /sup 22/Ne(α,n)/sup 25/Mg; interpretation of the solar /sup 48/Ca//sup 46/Ca abundance ratio and the correlated Ca-Ti isotopic anomalies in the Allende meteorite; Nilsson configurations in Rb to Y isotopes; $\gamma\gamma$ angular correlation measurements on /sup 148/Nd; search for decay of /sup 203/Au; identification of the new nuclides /sup 243/Np and /sup 244/Np; attempts to produce element 110 in fusion reactions of /sup 40/Ar with /sup 233,235,238/U. Charge distribution in the heavy wing in the reaction /sup 233/U(n/sub th/,f); isomeric ratios and angular momentum distribution for /sup 233/U(n/sub th/,f) in dependence of E/sub min/ of the fission products; test of an ionization chamber for yield measurements. Sub. coulomb transfer in heavy collisions; angular distributions and tilting mode in quasi-fission reactions; quasi-fission in the reaction /sup 40/Ar+/sup 208/Pb; binary reactions near the Coulomb barrier; excitation functions for the production of below target nuclides, search for pionic fusion; Separation and identification of /sup 99g/Tc; resonance-ionization mass spectrometry on Gd; capture and storage of Sr ions in a high frequency quadrupole trap; improvements on the laser system for resonance-ionization mass spectrometry; Radioactivity measurements after the Chernobyl reactor accident.

23985 (INIS-SU—385, pp 23-26) **Neon nucleus emission in /sup 233/U decay.** Tret'yakova, S.P.; Sehndulesku, A.; Zamyatnin, Yu.S.; Korotkin, Yu.S.; Mikheev, V.L. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Nuclear Reactions). 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780104. (N—7-85).

In JINR rapid communications. Collection.

A new type of decay of /sup 233/U by neon nucleus emission is discovered. The detection of neon among a great number of α particles was performed using track detector of polyethyleneterephthalate. At the exposition of 75 mg of /sup 233/U layer 16 decay events have been detected during 28 days. It corresponds to relative probability of the process with respect to α-decay lambda sub(Ne)/lambda sub(α)=(7.5 +- 2.5) x 10sup(-13). 9 refs.; 2 tabs.

23986 **Noise equivalent source for frequency domain measurements from the spontaneous fission of ^{252}Cf.** Mihalczo, J.T.; King, W.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **53**: 475-476(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

An experiment was performed to determine the frequency domain noise equivalent source from the spontaneous fission of ^{252}C. The measurements had maximum frequencies (<50 kHz) much lower than those corresponding to the frequencies associated with emission and detection times of particles from spontaneous fission of ^{252}Cf. This experiment was performed with a ^{252}Cf source on one plate of a parallel-plate ionization chamber and two large plastic scintillators (2 x 1 x 0.33 ft) at distances of 75 to 150 cm from the source. This noise equivalent source is important when using the ^{252}Cf source-driven neutron noise analysis method to determine subcriticality at low values of k/sub eff/ (<<0.8) because at low k/sub eff/ values, fluctuations of the neutron population in the system caused by the varying numbers of neutrons from spontaneous fission of ^{252}Cf become important. The noise equivalent source for these measurements has been formulated based on the Schottky formalism according to the method of Cohn.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 23855, 23937, 23939, 23942, 23979, 24178

23987 **(DOE/ER/05126—300) Nucleon optical potential: an extended three-body problem or a restricted infinite-body problem.** Redish, E.F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1986. Contract AS05-76ER05126. 20p. (ORO—5126-300; CONF-860832—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002265.

From 11. international conference on few-body systems in particle and nuclear physics; Tokyo, Japan (24 Aug 1986).

A three-body approach to the single-scattering approximation is developed for the nucleon-nucleus optical potential in the energy range 100 to 350 MeV. The kinematics of three-body momentum conservation and the systematics of the off-shell nucleon-nucleon T matrix leads to an effective interaction which is more non-local than those usually considered in non-relativistic models. Problems with the standard approach are pointed out and it is shown that the new non-locality can account for some of the effects previously assigned to relativity or the Pauli principle. (DWL)

23988 **(DOE/ER/40038—86-01) Configuration space Faddeev calculations: Progress report for period 1 January 1985-31 December 1985.** Payne, G.L.; Klink, W.H.; Polyzou, W.N. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1986. Contract AC02-81ER40038. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007556.

Three-body calculations provide a tool to identify the relevant degrees of freedom in the nucleus and to understand the interactions between these degrees of freedom. For the three-body system one can construct models that are simple enough so that exact numerical calculations can be performed. Thus, differences between the model results and the experimental results can be used to test the validity of the model. We have continued to develop the computer codes to obtain accurate solutions for the three-body problem in configuration space. Using these codes we have studied the effects of the three-body force on the three-body system, and we have begun a study of the magnetic moments of the trinucleon system. We have investigated the constraints on the current operators in relativistic quantum mechanical models. We have shown that these constraints lead to nonvanishing many-body contributions to the currents. Also, we have studied the connection between particle theories and field theories for the electromagnetic current operators. We have continued our program to obtain a representation of the scattering operator which satisfies unitarity, causality, cluster properties, and space-time invariance. 11 refs.

23989 **(GSI—86-46-Prepr.) Pion and photon bremsstrahlung in a heavy ion reaction model with friction.** Stahl, T.; Uhlig, M.; Mueller, B.; Greiner, W.; Vasak, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1986. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751236.

Based on a classical dynamical model of nuclear motion with a velocity dependent friction force we calculate pionic and electromagnetic bremsstrahlung emitted in heavy ion collisions with bombarding energies between 20 and 84 MeV/n. For arbitrary projectile-target combinations and with a fixed value of the only parameter of the model, the friction coefficient κ, our calculations reproduce the observed beam energy and target mass dependence for pions. The gamma yields, calculated with the same value of κ, reproduce the measured dependence of the cross-section on energy and target mass, but underestimate the published data by a factor

two. This is a good agreement in view of the discrepancies between different experimental groups.

23990 **(IC—86/52) Application of nuclear data to the research of nuclear theory.** Xu Fuxin. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701425.

The paper applies the related data from the work of Wapstra and Bos to the following three aspects with a satisfactory result: 1) the new formula of binding energy fixed by nuclear data and the least square method; 2) a comparison of shell correction terms in the nuclear mass formulas and 3) an analysis for location of beta stable line and curvature of mass parabola. 8 refs.

23991 **(IC—86/128) Coupled mass-asymmetry and relative motion coordinates for the collective alpha-particle transfer resonances.** (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701432.

The dynamical fragmentation theory is extended to include the coupling between mass-asymmetry and relative-motion coordinates and its effect on α-particle transfer resonances is studied. For 75 MeV /sup 16/O+/sup 40/Ca reaction, this coupling is shown to be of the negligible order for the α-particle transfer yields. 15 refs, 3 figs, 1 tab.

23992 **(IC—86/160) Eikonal multiple scattering model within the framework of Feynman's positron theory.** Tekou, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701525.

The Bethe Salpeter equation for nucleon-nucleon, nucleon-nucleus and nucleus-nucleus scattering is eikonalized. Multiple scattering series is obtained. Contributions of three body interations are included. The model presented below may be used to investigate atomic collisions. 36 refs.

23993 **(IC—86/200) Skyrme interaction and the properties of cold and hot neutron matter.** Mansour, H.M.M.; Hassan, M.Y.M.; Ramadan, S. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701539.

The binding energy per particle, effective mass, magnetic susceptibility, etc for neutron matter are calculated using the Skyrme interaction SKII. Relativistic corrections to the non-relativistic Skyrme effective interaction to order 1/C/sup 2/ are also used to calculate the corrections for the binding energy of neutron matter. The correction is very small for small values of k/sub h/ and increases as k/sub n/ is increased. The thermal properties of neutron matter are calculated also using SKII force. The temperature dependences of the volume and spin pressure are determined. The results obtained show a similar trend as previous theoretical estimates by different methods of calculation. 17 refs, 4 figs, 2 tabs.

23994 **(INIS-mf—10299) Electromagnetic properties of the three-nucleon ground state.** Strueve, W. (Hannover Univ. (Germany, F.R.). Fachbereich Physik). 15 Feb 1985. 152p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751189.

The electromagnetic form factors of the three-nucleon ground state are calculated on the base of an exact solution of the Faddeev equations. In a Hilbert space of nucleons and a possible Δ-isobar the effects of a non-perturbative description of the Δ-isobar on the magnetic form factors are studied. Pure nucleonic current operators with two- and three-particle character can be described in the extended Hilbert space by simpler one-body operators. Additionally nonrelativistic meson-exchange corrections due to π and rho exchange are calculated consistently with the requirements of current conservation. Further relativistic corrections are estimated on selected examples. The calculations yield a total magnetic contribution of the Δ-isobar which is smaller than hitherto assumed, a static approximation of the Δ propagation is proved as inadmissible and must be rejected. Together with the meson-exchange corrections a well agreement with the experimental data at low momentum transfers results. Especially the magnetic moments and magnetization radii can be explained. For higher momentum transfers the results show the importance of further corrections. The regard of selected relativistic corrections leads to a good description of the experimental magnetic form factors. Also by this way the position of the minimum and the height of the second maximum in the /sup 3/He charge form factor can be explained. The comparison with the latest experimental results reveals furthermore unresolved problems in the description of the /sup 3/H charge form factor.

23995 **(INIS-mf—10300) Microscopic description of electromagnetic transitions and photonuclear reactions.** Mertelmeier, T. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 21 May 1985. 149p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751192.

In the present thesis in the framework of the Cluster model the so-called refined resonating-group method is extended in order to describe electromagnetic properties and photonuclear processes in light nuclei. For this the matrix elements of the electromagnetic transition operators of arbitrary multipolarity are explicitely given in the long-wave approximation, whereby these integrals are calculated by means of the generating functions of the spherical harmonics and quadratic supplement. As application it succeeds to reproduce well the electromagnetic moments and transitions between bound states of the nuclei /sup 6/Li and /sup 7/Li. Furthermore the radiative capture reaction /sup 3/He(α,γ)/sup 7/Be is studied at low energies. As further application we calculate the electric polarizability of /sup 7/Li which is obtained in the sub-Coulomb scattering on heavy ions from the experimental analysis. (orig./HSI).

23996 **(INIS-mf—10324) Real and imaginary part of the potential between two nuclei and the realistic nucleon-nucleon interaction.** Trefz, M. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 19 Jun 1985. 131p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751197.

Starting from a realistic nucleon-nucleon interaction (Reid soft-core) in the model of two infinitely extended confusing nuclear matter complex energy densities are calculated by means of a G matrix. By means of a generalized local-density approximation the results are transferred to finite nuclei. In the framework of the frozen-density approximation in the energy-density formalism a complex potential between two nuclei is calculated. The potential calculated so contains not the contribution of 1-particle-1-hole states to the optical potential. The contribution of these states is therefore calculated in the Feshbach formalism, respectively these states are explicitely regarded in coupled-channel calculations. The model is applied to light (for instance /sup 12/C+/sup 12/C), medium heavy (for instance /sup 48/Ca+/sup 48/Ca), and heavy (for instance /sup 40/Ar+/sup 208/Pb) systems. Potentials for incident energies of 5-84 MeV per projectile nucleon are calculated. By means of these potentials differential cross sections and reaction cross sections are determined and compared with the experimental data. The energy dependence of the reaction cross section is discussed. It is shown that at higher energies (40 MeV/N) the differential cross sections can be quantitatively reproduced. For the reaction cross section in the whole energy range good agreement with the experiment is obtained. Contrarily to current theoretical models it is proved that at low energies the excitation of collective states yields a large contribution to the reaction cross section and therefore must not be neglected.

23997 **(INIS-mf—10337) Effects of the angular-momentum projection on cranking wave functions.** Wuest, E. (Giessen Univ. (Germany, F.R.). Fachbereich Physik). 23 Mar 1984. 169p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87751313.

In this thesis the influence of the angular-momentum projection in cranking Hartree-Fock-Bogolyubov wave functions was studied by the "variation before projection" method. This study is equivalent to the question how well the cranking wave function represents an angular-momentum eigenstate because cranking represents an approximate angular-momentum projection. (orig./HSI).

23998 (INIS-mf—10589, pp 14-15) **Some problems of high energy nuclear physics.** Dolejsi, J.; Formanek, J. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

23999 (INIS-mf—10589, pp 61-62) **Gallagher-Moszkowski pairs in /sup 188/Re nucleus.** Sterba, F.; Nosek, D. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24000 (INIS-mf—10589, pp 63-64) **E1 decay of the IπK=5/2- 5/2 and 7/2- 7/2 states in the /sup 161/Tb nucleus.** Sterba, F.; Nosek, D. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24001 (INIS-mf—10589, pp 102-103) **Spin-orbit interaction of sigma hyperon and spectra of light hypernuclei.** Majling, L.; Sotona, M.; Zofka, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24002 (INIS-mf—10589, pp 65-66) **Effect of the ΔN=2 interaction on direct one-nucleon transfer reactions.** Holan, P.; Prazak, J. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24003 (INIS-SU—378, pp 3-7) **Inelastic scattering of photons on deuterons and neutron polarizability.** Levchuk, M.I.; L'vov, A.I.; Petrun'kin, V.A. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780101.

Kratkie Soobshcheniya po Fizike.; No. 2.

In Experimental and theoretical physics. Collection.

The differential cross section of γD -> γ' reaction at 300 MeV energy of an incident photon and small proton momentum, which turned out to be sensitive to the sign of π/sup 0/ -> 2γ decay constant, is calculated at impulse approximation based on the interaction of a final state.

24004 (INIS-SU—385, pp 45-50) **Behaviour of nucleon-sixquark system on temperature-density plane.** Chizhov, A.V.; Nazmitdinov, R.G.; Shumovskij, A.S.; Yukalov, V.I. (Moskovskij Gosudarstvennyj Univ., USSR; Tashkentskij Gosudarstvennyj Univ., USSR; Joint Inst. for Nuclear Research, Dubna, USSR). 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780104. (N—7-85).

In JINR rapid communications. Collection.

On the basis of the model describing the heterogeneous states in nuclear matter the dependence of the behaviour of a two-phase system of nucleons (fermions) + sixquarks (bosons) is investigated at the temperature (theta) and density (rho). Every phase is the collection of n-quark colourless clusters (n3 for nucleus and n=6 for sixquark) described as the Van-der-Waalse gas. Analysis demonstrates the advantage of the heterogeneous state for a wide region of theta and rho. 12 refs.; 5 figs.

24005 (INIS-SU—392, pp 216) **Development of deformation in molybdenum isotopes.** Guseva, I.S.; Efimov, A.D.; Mikhajlov, V.M.; Kharitonov, Yu.I. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24006 (INIS-SU—392, pp 422) **Mean-square radii of charge distribution in /sup 6/Li, /sup 7/Li nuclei.** Kostin, R.L.; Trubnikov, S.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24007 (INIS-SU—392, pp 440) **On the shell potential choice for description of the 1d2s-shell nucleus photodisintegration.** Gol'tsov, A.N.; Ishkhanov, B.S.; Orlin, V.N.; Sapunenko, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24008 (INIS-SU—392, pp 454) **Operator pairing convolutions and exciton relaxation.** Isaev, P.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24009 (INIS-SU—392, pp 455) **Giant resonances and stability of the nucleus-soliton.** Kartavenko, V.G. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24010 (INIS-SU—392, pp 346) **Study on the competition of the (γ,p) and (γ,n) reactions on self-conjugate nuclei.** Ishkhanov, B.S.; Kapitonov, I.M.; Mokeev, V.I. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24011 (INIS-SU—392, pp 453) **Quasiparticle kinetics in heavy ion reactions: peripherality approximation in the strong coupling regime.** Isaev, P.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24012 (INIS-SU—392, pp 457) **Distribution of secondary nucleons in kinetic energy in the quantum shock wave model.** Krylovetskij, A.G. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24013 (INIS-SU—392, pp 467) **Electrodisintegration of the polarized deuteron with the Δ isobar excitation.** Rekalo, M.P.; Gakh, G.I.; Korzh, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24014 (INIS-SU—392, pp 473) **On a peculiarity momentum distribution in proton-nucleus reactions in dependence on mass numbers.** Arushanov, G.G.; Ismatov, E.I.; Arushanov, V.G.; Kirson, I.M. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24015 (INIS-SU—392, pp 484) **Separation of contributions of the direct and statistical mechanisms in reactions with arbitrary spin structure in the analysis of nuclear cross section fluctuations.** Kun, S.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24016 (INIS-SU—392, pp 485) **Identification of the intermediate structure in a reaction in the presence of statistical fluctuations.** Vydrug-Vlasenko, S.M.; Kovalenko, A.I.; Kun, S.Yu.; Tsekhmistrenko, I.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24017 (INIS-SU—392, pp 490) **Probability of the D-state in deuteron on the base of electrodisintegration data.** Komarov, V.V.; Trishchenko, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24018 (INIS-SU—392, pp 491) **Relativistic invariant analysis of polarization phenomena in deuteron electrodisintegration near threshold.** Afanas'ev, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24019 (INIS-SU—392, pp 503) **Effect of nucleus deformability on the diffraction scattering of intermediate-energy neutrons.** Polozov, A.D.; Skorobogatov, P.V.; Tartakovskij, V.K. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24020 (INIS-SU—392, pp 505) **Taking into account for direct mechanism contribution to cross section of the fast neutron inelastic scattering on sup(164-170)Er nuclei.** Kabesas, R.; Miko, G.; Garsiya, F. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24021 (INIS-SU—392, pp 509) **Role of exchange processes in the cluster knockout reactions by mean-energy protons.** Vdovin, A.I.; Golovin, A.V.; Loshchakov, I.I. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

24022 (INIS-SU—395, pp 19-23) **Bimodal fission in the shell-correction approach.** Pashkevich, V.V.; Sehndulesku, A. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780088. (N—16-86).

In JINR rapid communications. Collection.

It is shown that in the theoretical description of the fission process in the nucleus /sup 26/+H4Fm ther turn out to be two valleys on the potential-energy surface in the region of the scission point. One valley corresponds to the compact configuration of two nearly spherical fragments; and the other, to more separated strongly alongated fragments. Only mirror-symmetric shapes were considered. 17 refs.; 2 figs.

24023 **(INP—1227/PL) Hydrodynamical space-time evolution of the central region of rapidities in ultra-relativistic heavy ion collisions.** (Institute of Nuclear Physics, Krakow (Poland)). 1983. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701430.

The solutions of the hydrodynamic equations describing a longitudinally expanding quark-gluon plasma produced in central collisions of two large nuclei are investigated. It is argued that a fair description of the transverse flow of plasma is given - irrespective of the initial conditions - by the relativistic simple wave of Riemann, modulated by a factor resulting from cooling due to the longitudinal expansion of plasma. The role of fluctuations in the flow of plasma is also briefly discussed.

24024 **(ITEP—78(1985)) Studying the space structure of NN interaction.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701433.

The potential of the NN interaction Vsub(NN) is constructed with the account of coupling between the NN and the six-quark components of the wave function. To describe the NN interaction the collective variable rhosup(2) is used which is proportional to the sum of the quarks distances from the 6sub(q) centre-of-mass squared. Potential Vsub(NN) at rho -> infinity coincides with the one-exchange potential. At rho -> 0 potential Vsub(NN) increases as the energy of quarks localized in a small volume grows; this increase of the quark energy manifests itself as a repulsion in the 6q-system. The combined action of the repulsion at small rho and the confinement forces results in the transition nucleons 6q-bag occuring only in the narrow range around rho approximately equal to 1.5 fm. The constructed potential provides good description of the scattering lengths, effective radii and S-wave NN scattering phase shifts in the energy range of Tsub(lab) approximately equal to 600-800 MeV. 18 refs.; 4 figs.; 1 tab.

24025 **(ITF—86-51-R) Relativistic effects in deuteron electrodisintegration process.** Anchishkin, D.V.; Vizireva, L.; Kobushkin, A.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701581.

The problem of deriving the nucleon momentum distribution in a deuteron (NMDD) from the d(e, e'p)n reaction cross section is discussed in terms of light-cone dynamics. The main relativistic effect is shown to be the distinction of the relativistic internal momentum of a bound np-system from the nonrelativistic one. The relativistic description enables one to agree NMDD derived from the (e, e'p) reaction data and NMDD derived from the (d, p) and (e, e') reactions. 11 refs.; 5 figs.

24026 **(JINR—E-4-85-934) Alpha-like four nucleon correlations in the superfluid phase of atomic nuclei.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701436.

An interplay between the pairing correlations and the α-like four-nucleon correlations (α-type correlations) in the ground and low-lying excited states is of /sup 152/Nd, /sup 156/Sm, /sup 160/Gd, /sup 164/Dy, /sup 168/Er, /sup 176/Hf, /sup 180/W, /sup 184/Os, /sup 240/Pu, /sup 246/Cf nuclei predicted within a BCS-like model. It is shown that these α-type correlations are especially important in describing the α-clusterization process (the spectroscopic factors entering the α-decay and α-transfer reaction probabilities). It is also shown that the region of superfluid nuclei is enlarged due to the fact that the usual BCS neutron and proton super-

fluidity can mutually be induced by one another via the α-type correlations. 26 refs.; 1 fig.; 2 tabs.

24027 **(JINR—E-4-86-86) Analysis of the neutron energy spectra from the sup(208)Pb (p,n) sup(208)Bi reaction at Esub(p)=200 MeV.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701434.

Submitted to the journal Yad. Fiz. .

Microscopic calculation of the small-angle neutron energy spectra from the /sup 208/Pb (p, n) /sup 208/Bi reaction at Esub(p)=200 MeV are presented. It is shown that the distorted-wave impulse approximation and the microscopic theory of finite Fermi systems can be employed for describing the low-energy excitation region 0 <= Q <= 30 MeV with small momentum transfers. A quantitative estimate is obtained for the local charge of quasiparticles esub(q)[σtau]=0.8 that characterizes the quenching of the integral strength of spin-flip low-energy transitions and the relevant effects are discussed. 28 refs.

24028 **(JINR—R-4-85-908) Unified semimicroscopic description of the scattering of flow energy protons and α-particles on nuclei.** (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701435.

Submitted to the journal Z. Phys. .

A unified semimicroscopic approach to description of nucleon and low-energy α-particle interaction with nuclei is formulated. Using effective nucleon-nucleon interaction elastic and inelastic 25.05 MeV proton scattering and 104 MeV α-particle scattering on /sup 90/Zr nucleus are analysed. The effect of the Pauli principle and effective force dependence densities on the angular distributions of scattered particles is investigated. ECIS program is modified and numerical realization of semimicroscopic method of coupled channels for X-radiation surces is described. Stability of frequency of X-ray pulses on variation of voltage of a low-voltage power same effective nucleon-nucleon interaction a good decription of experimental angular distributions of elastic- and inelastic-scattered protons and α-particles is obtained. Account of exchage nucleon-nucleon correlations conditioned by the effect of the Pauli principle results in increase of elastic scattering cross sections for large scattering angles improving the description of cross sections. 34 refs.

24029 **(JINR—R-4-85-960) Giant angular resonance and structure of the lowest nuclear states.** Mikhajlov, I.N.; Usmanov, P.N.; Yuldashbaeva, Eh.Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701426.

The analysis is given of the Hamiltonian of the "two-rotor" model, which is based on the assumption that the "giant angular resonance" exists, i.e. that it is possible to rotate the neutron component of a deformed nucleus as a whole with respect to the proton component. The realization of the projections on the intrinsic axes of the angular momentum operators is found; the Hamiltonian matrix is determined in the basis convenient for the case of a strong coupling between neutrons and protons. The spectrum of the-rotor model is determined taking into account the off-diagonal matrix elements in the lowest order of the perturbation theory. The γ-factors and the probabilities of the M1-transitions are discussed. 7 refs.; 2 figs.

24030 **(JINR—R-4-86-42) Introduction of generator coordinates by the local-scale transformation method.** Marinova, L.P.; Stoitsov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701427.

Submitted to the journal Teor. Mat. Fiz. .

A new way for introducing collective degrees of freedom in the framework of the generator-coordinate method /GCM/ is suggested in terms of local-scale point transformations. It is shown that the collective motions, connected with the local density evolution, can be described by single generator coodinate. The investigation of the collective properties of the system is reduced to a determination of two functions: i/ the weighting functions in the GCM, and ii/ a scalar function related to the local density of the system. The suggested approach is compared with GCM where the generatot coordinates are determined by the constrained Hartree-Fock method. 14 refs.

24031 **(JINR—R-4-86-53) On the algebraic structure of the Hamiltonian with a quadrupole interaction.** Atanas'er, G.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701428.

Submitted to the journal Z. Phys., A. .

The exact group of dynamical symmetry for the Hamiltonian with a quadrupole interaction Sp(3, R) is found. This permitted to map the initial fermion space into the model boson one and find energy eigenvalues for the simplest realization of the Sp(3, R) generators. It is demonstrated that one can arrive at the Hamiltonian of the treated model by the successive symmetry breaking with respect to Sp(3, R) and its subgroups. The reasons are given for the good description of the experiment by the interacting boson model and standard semimicroscopic model. 18 refs.; 4 figs.

24032 **(Juel—2068) Nuclear structure and reaction mechanisms studied on alpha-particle transitions.** Oelert, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bochum Univ. (Germany, F.R.). Fakultaet fuer Physik und Astronomie). Jun 1986. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751284.

Since the observation of the natural alpha decay of atomic nuclei the alpha particle was and is considered as an important component of the nuclear matter. The modern studies of alpha-particel transfer reactions are devoted to the question on four-particle correlations (alpha-particle clusters) generally in nuclear matter or also on nuclear surfaces. Thereby one is today yet absolutely far away from a unified picture of the mechanism of the alpha transfer: It is shown that different reaction and nuclear models must be used with different success for the interpretation of the data. Theoretical and experimental determination of spectroscopic strenght distribution were thereby developed mutually supportingly each other. On the experimental side the question of the reaction mechanism and the determination of its details is to be clarified. Here approaches were developed which lead to a unified description in the sd shell. Calculations in the formalism of the coupled channels with spectroscopic factors calculated in the framework of the shell model lead to convincing agreements between theoretical and experimental angular distributons regarding both their shape and their amplitude. Hereby it was shown that beside the determination of the potential parameters a two-stage reaction mechanism as in an alpha-particle transition after or before an inelastic excitation of the traget or residual nucleus is of decisive importance. (HSI).

24033 **(Juel-Spez—340) Subbarrier fusion and the quantized adiabatic time-dependent Hartree-Fock theory.** Gissler, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.)). Dec 1985. 117p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751217.

The subbarrier fusion of realistic heavy ion systems is numerically calculated in the frame of the quantized adiabatic time dependent Hartree-Fock theory using Skyrme interactions. (BRB).

24034 **(Juel-Spez—341) Calculation of the binding energy per nucleon and the quasi-particle interation in nuclear matter under consideration of relativistic medium effects.** Hippchen, T. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1985. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751218.

In a first part, nuclear matter calculations have been performed in the Dirac-Brueckner approach using a) a nucleon-nucleon potential of one-boson-exchange (OBE) type and b) a more

realistic interaction in which the fictitious σ-exchange of the OBE-model is replaced by explicit 2π- and πrho-exchange diagrams. Both potential models yield the correct empirical binding energy and saturation density. It turns out that the total sum of relativistic effects caused by the emplicit 2 π- and πrho-exchanges is comparable to those due to σ-exchange. In a second part, the nuclear quasiparticle interaction, i.e. the Landau parameters, have been calculated in the central (F), isospin (F'), spin (G) and spin-isospin (G') channel, in an analogous way. Compared to nonrelativistic calculations (including conventional medium corrections like Pauli and dispersion effects), a strong improvement has been found, especially in the F- and G-channel. Finally, the influence of A/sub 1/-exchange is studied, in NN scattering and in nuclear matter. It turns out that, after a suitable and necessary readjustment of some meson parameters, its role is negligibly small.

24035 **(Juel-Spez—371) Study of the (/sup 3/He,t) reaction and the (p,n) reaction at intermediate energies.** Schulte, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Bonn Univ. (Germany, F.R.)). Sep 1986. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751233.

Within the framework of the Distorted Wave Impulse Approximation (DWIA) a method is presented for the calculation of inelastic and charge exchange scattering processes induced by composite particles. The in those reactions often neglected knockon-exchange contributioins are treated exactly. The basic tool is the multipole expansion method which is repeatedly applied to perform multidimensional integrals involved in both the direct and exchange amplitudes. Based on that method a computer code is developed and is applied to examine the recoil and tensor exchange effects for different multipoles. Neglecting those effects 10-30% error shows up in the calculations. A comparative study of the /sup 90/Zr(/sup 3/He,t)- and /sup 90/Zr(p,n)-reactions is then performed at the bombarding energy of 200 MeV per nucleon. It is shown that the (/sup 3/He,t)-reaction excites the collective 1 $\hbar\omega$ - (L=1) - and 2 $\hbar\omega$ - (L=2) - spin-flip modes much more strongly than the (p,n)-reaction. The reason for that is found in the strong surface character of the (/sup 3/He,t)-reaction. It is proved that both the (p,n)- and (/sup 3/He,t)-spectra are nearly background free and represent a linear spin-isospin (σtau)-response of the target nucleus to the probing (p,n)- and (/sup 3/He,t)-fields, respectively. (orig./HSI).

24036 **(KAERC—102/85) On nonaxial nuclear model with central symmetry and excited states of deformed nuclei (2).** (State Committee for Atomic Energy, Pyongyang (D.P.R. of Korea). Research Center for Atomic Energy.). 1985. 7p. (In Korean). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701429.

In this paper the collective excited energy formula for deformed nuclei has been derived, which is dependent only upon two parameters α(nonaxial parameter) and xi. The case $\alpha=0$ corresponds to an axial nucleus and αnot=0 to nonaxial nucleus. In case of xi=0, the formula is identical with the formula of the axial nuclear model. And in case of xi>>1, the formula leads to the "heuristic formula" for the energy level of the axial nuclear model.

24037 **(KFKI—1986-53/A) Heavy ion collisions and anisotropic hydrodynamics.** (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Sep 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701431.

A generalized hydrodynamical equation system was constructed in which the anisotropy of the momentum distribution is added as a new variable. These equations are derived from the moment equations of the relativistic Boltzmann equation where the closure of the set is achieved by assuming a particular class of initial conditions. The equations are then explicitly solved for two uniform interpenetrating hadron streams. The collision cross-sections are the bare hadron cross-sections; the presence of the other hadrons can be simulated by the use of a density and energy density dependent temperature and mass, taken from self-consistent calculations. The results are compared with other theoretical results. It was found that the isotropization occurs sufficiently rapidly for medium energy head-on collisions to reach local thermal equilibrium. 18 refs.; 4 figs.

24038 **(LUIP—8503) Studies of many-particle correlations in proton-nucleus interactions using distributions of rapidity-gaps between particles.** Mangotra, L.K.; Otterlund, I.; Stenlund, E. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). 26 Mar 1985. 10p. (LUNFD6/NFFK—7056-1-9(1985)). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750904.

Many-particle correlations in proton-Emulsion interactions at 400 GeV have been investigated using distributions of rapidity-gaps between particles. We have defined the normalized semi-inclusive rapidity-gap correlation function which is shown to have advantages over the normalized two- particle correlation function. Small, but significant, deviations from zero-correlations are observed in the data.

24039 **(NORDITA—84/46-Prepr.) Skyrmions, dense matter and nuclear forces.** Pethick, C.J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Dec 1984. 22p. (CONF-8409225—4-Prepr.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87751240.

From Colloquium on heavy ion collisions: from collective motions to quarks; Cargese, France (2 Sep 1984).

A simple introduction to a number of properties of Skyrme's chiral soliton model of baryons is given. Some implications of the model for dense matter and for nuclear interactions are discussed.

24040 **(NORDITA—85/25-Prepr.) Quantal foundation of the nucleon exchange transport theory.** Randrup, J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Jul 1985. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751243.

The central elements of the nucleon exchange transport theory are discussed within a fully quantal framework in order to elucidate the principal characteristics, validity and limitations of the theory. Special consideration is given to the mean rate of energy dissipation and the penetrability coefficient.

24041 **(OUP—83-17) Study of two-body effects in the particle-rotor model.** Henriquez, A. (Oslo Univ. (Norway). Fysisk Inst.). Apr 1983. 89p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750897.

Some well known difficulties of the particle-core coupling model have been studied. It seems that the inclusion of the full recoil term and an exact diagonalization of the pairing interaction, with state-dependence in the case of actinides, indicate a solution to the following problems: the range of $\Delta N=2$ interaction in the hexadecapole and quadropole deformation planes, the description of the low spin anti-aligned states in /sup 109/Pd, and the Coriolis attenuation factor in the rare earth nuclei and in /sup 235/U.

24042 **(OUP—86-19) First generation of γ-rays from hot nuclei.** Guttormsen, M.; Ramsoey, T.; Rekstad, J. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750684.

A method to extract first generation γ-ray spectra from nuclear levels at high excitation energy is described. The method that is applied and tested to data from the (/sup 3/He,$\alpha\gamma$) reaction in the rare earth region, is based on the assumption that states populated after the first γ-transition have the same decay properties as states populated directly in the particle reaction at that excitation energy. Some experimental first generation γ-ray spectra are presented.

24043 **Quark-cluster-model predictions for the nuclear Drell-Yan process.** Harindranath, A.; Vary, J.P. (Physics Department, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **34**: No. 11, 3378-3384(1 Dec 1986).

We evaluate the quark-cluster-model predictions for lepton pair production in proton-nucleus, pion-nucleus, and nucleus-nucleus interactions. We examine the issue of a possible ambiguity between the K factor and the probability of six-quark clusters in nuclei. We present predictions for cross sections and cross-section ratios which show substantial sensitivity to different features of the model. The model compares well with the existing data.

24044 **A momentum dependent induced interaction model applied to liquid^{3}He.** Ainsworth, T.L. (Univ. of Arizona, Tucson, AZ). pp 129-138 of Condensed matter theories: Vol. 1. Malik, F.B. New York, NY; Plenum Press (1986). (CONF-8508135—).

From 9. international workshop on condensed matter theories; San Francisco, CA, USA (5 Aug 1985).

This paper describes a generalization of the Babu-Brown induced interaction model. A momentum dependence is included in the induced interaction in order to maintain the antisymmetry of the quasi-particle interaction to preserve the forward scattering sum rule (Pauli principle). In addition to the RPA particle-hole interaction (t-channel) the exchange particle-hole channel (u-channel, induced interaction) is included. The equations which self-consitently sum the one-particle-one-hole reducible diagrams are shown. It is shown that both particle-hole reducible channels are important for calculating the quasi-particle interaction near the Fermi surface and by including both on an equal basis the resultant scattering amplitude is inherently antisymmetric.

24045 **Thermal response of hot nuclei.** Vary, J.P.; Bozzolo, G.; Miller, H.G.; Quick, R.M. (Iowa State Univ., Ames, IA). pp 165-172 of Condensed matter theories: Vol. 1. Malik, F.B. New York, NY; Plenum Press (1986). (CONF-8508135—).

From 9. international workshop on condensed matter theories; San Francisco, CA, USA (5 Aug 1985).

The authors evaluate an effective Hamiltonian (H/sub eff/) in a sequence of model spaces, abbreviated as two-space (0s, 0p and 1s-0d shells), the three-space (two-space plus 1p-0f shell), the four-space (three-space plus 2s-1d-0g shell) and the five space (four-space plus 2p-1f-0h shell). This sequence of model spaces permits one to estimate convergence properties of the finite temperature Hartree-Fock (FTHF) approximation results. For all these calculations all particles are active and only isospin symmetry is insured by requiring that the neutron and proton orbitals are degenerate. Two overall factors, for the kinetic energy and effective interaction terms, respectively are introduced and later adjusted, simultaneously with the oscillator spacing, to achieve the desired rms radius and binding energy for a given nucleus for each choice of model space. The theoretical rationale for the approximate values of these parameters and expected dependence on model space, together with the resulting numerical values are discussed.

24046 **Trinucleon bound states.** Friar, U.L. (Los Alamos National Lab., Los Alamos, NM). pp 213-250 of New vislas in electro-nuclear physics. Tomusiak, E.L.; Caplan, H.S.; Dressler, E.T. New York, NY; Plenum Press (1986). (CONF-850851—).

From NATO advanced study institute on new vistas in electro-nuclear physics; Banff, Alberta, Canada (22 Aug 1985).

Because the technical aspects of the few-nucleon problem tend to obscure the many simple results, the author concentrates on understanding why three-body calculations are done the way they are, in what sense they are complicated, and in what sense they are simple. Electromagnetic interactions are studied involving three nucleons. Three-body forces are examined also. It is noted that in isovector magnetic dipole processes, pion-exchange currents can make sizeable contributions. Contributions from heavy-meson exchange are smaller, because nucleons don't like to overlap at small separations. The dominant meson-exchange effects occur in the isovector current operator, while small (ambiguous) contributions can occur to the charge, isoscalar current, and axial vector current operators.

24047 **Electron scattering from nuclei at several GeV.** Arnold, R.G. (American Univ., Washington, DC). pp 61-100 of New vistas in electro-nuclear physics. Tomusiak, E.L.; Caplan, H.S.; Dressler, E.T. New York, NY; Plenum Press (1986). (CONF-850851—).

From NATO advanced study institute on new vistas in electro-nuclear physics; Banff, Alberta, Canada (22 Aug 1985).

The experiments described are electron scattering measurements from nucleon and nuclear targets using electrons in the GeV energy range. Inelastic scattering is discussed, with an emphasis on deep-inelastic lepton scattering from nuclei and the recently discovered distortion of quark momentum distributions in nuclei, called the EMC effect.

24048 **High nuclear temperatures by antimatter-matter annihiliation.** Gibbs, W.R.; Strottman, D. (Arizona State Univ., Tempe, AZ). pp 419-430 of Antinucleon-and nucleon-nucleus interactions. Walker, C.E.; Goodman, C.S.; Olmer, C. New York, NY; Plenum Press (1985). (CONF-850315—).

From Conference on antinucleon and nucleon-nucleus interactions; Telluride, CO, USA (18 Mar 1985).

The authors investigate the properties of nuclear matter by possibly raising the energy density of a localized region of nuclear material. They consider raising the energy density of some fraction of the nucleus to that of a nucleon, or raising the kinetic energy of the nucleons to a "temperature" of the order of 180 MeV. It proposed to try to create this new form of matter by collisions of heavy ions, but the authors suggest a possible alternative through the use of antiproton beams.

24049 **Antinucleon physics.** Eisenstein, R.A. (Nuclear Physics Lab., Univ. of Illinois, Champaign, IL). pp 467-470 of Antinucleon-and nucleon-nucleus interactions. Walker, C.E.; Goodman, C.E.; Olmer, C. New York, NY; Plenum Press (1985). (CONF-850315—).

From Conference on antinucleon and nucleon-nucleus interactions; Telluride, CO, USA (18 Mar 1985).

One of the basic thrusts of low-energy antinucleon physics is the study of QCD in the low-energy regime. Important features of the ASTERIX experiment are discussed, including the exclusive searches for "glueballs" and other exotic structures such as qqqq or hermaphrodies such as gqq. The author comments on discussions of low-energy p physics which clearly indicate there are many interesting questions requiring investigations.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 24172, 24334, 24344, 24344

24050 **(AD-A—175711/1/XAB) New version of the energy-deposition code D-DEP-1: better stopping powers. Final report.** Davisson, C.M.; Manning, I. (Naval Research Lab., Washington, DC (USA)). 6 Oct 1986. 76p. (NRL—8859). NTIS, PC A05/MF A01.

This new version of the E-DEP-1 program uses improved stopping powers that have been developed since the original program appeared. The stopping-power cross sections in the original paper were based on the Thomas-Fermi interatomic potential. The present version uses the elastic stopping power which is based on a much more realistic interatomic potential, and for the inelastic stopping power the phenomenological fit. In addition, some minor corrections have extended the range to higher energies, and three dummy routines with full sets of common statements to allow the user to use the data as he or she sees fit. The present version is consistent with FORTRAN IV and has been tested with both DEC FORTRAN 66 and FORTRAN 77. The Fortran program is included in the report, and the output is given for the sample run used in the original version, but now using this version. Figures show a comparison between the two.

24051 **(CONF-870424—7) Fine-mesh limit of 1D nodal transport equations.** Gelbard, E.M.; Liu, Y.W.H.; Olvey, L. (Argonne National Lab., IL (USA); National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Nuclear Engineering; Northwestern Univ., Evanston, IL (USA). Dept. of Mechanical Engineering). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006992.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

Imbedded in multidimensional nodal transport codes is the solution of transverse integrated ID transport equations. Since, in this solution, fluxes on boundaries are DP_1, it is generally assumed that the ID solutions, in the small-mesh limit, approach DP_1 solutions. It will be shown that this is not true. Small-mesh limits of the ID nodal equations will be derived, and it will be shown that these are substantially worse than the DP_1 equations under certain cir-

cumstances. Alternate ID nodal equations (which do have a DP_1 small-mesh limit) are proposed. 2 refs.

24052 (EUR—9762-Vol.1, pp 183-192) **Measurement of neutron differential scattering cross sections for ^{12}C, ^{14}N and ^{16}O in the energy range 20-26 Mev.** Petler, J.S.; Finlay, R.W.; Meigooni, A.S.; Islam, M.S.; Rapaport, J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The Ohio University Beam Swinger provides a high resolution, low back-ground time-of-flight facility for the measurement of elastic and inelastic neutron scattering. It has been used to obtain a comprehensive set of differential scattering cross sections for ^{12}C, ^{14}N, ^{16}O and ^{40}Ca between 18 and 26 MeV. The elastic cross sections can be used directly to obtain partial kerma factors and, combined with the known total cross sections, provide accurate values for the reaction cross sections. Angular distributions have been measured for inelastic scattering from all the nuclear levels that cannot decay by particle emission thus providing (by subtraction) a limit on the sum of all charged-particle producing reactions. The integrated cross sections for inelastic scattering from some particle-unstable states in ^{12}C are in excellent agreement with the cross sections for three-body breakup obtained by Antolkovic et al. The differential data have been used, together with higher energy proton scattering data to produce energy-dependent optical model parameters for each of these nuclei in the energy range 20-60 MeV. It has been found that the elastic differential cross sections at theta $>$ 100^0 for ^{12}C, ^{14}N and ^{16}O cannot be well described by a spherical optical model. Explicit consideration of coupled-channel effects, and in the case of ^{12}C, deformation of the ground state, improves the agreement between calculation and experiment. Heavy ion recoil kerma factors and reaction cross sections have been obtained for each element and compared with previous calculations and measurements.

24053 (EUR—9762-Vol.1, pp 245-253) **Dose mean lineal energy for computer simulated proton tracks.** Leuthold, G.; Burger, G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

In the analysis of neutron radiological efficiency, the quantity mean ysub(D) may play a helpful role. As the protons are dominant in the secondary particle spectrum in the majority of neutron exposure cases, in radiation protection as well as radiation therapy, mean ysub(D) was first determinated for protons. Proton tracks were computer simulated by Monte Carlo calculations in the proton energy range from 0.3 - 1.5 MeV in water vapour. From the event structure the proximity functions T(x) were derived. They are defined as weighted sums of energy transfers within spheres of radii $r < = x$ around each event point of a track. For purposes of track analysis one may distinguish four different components: - contribution of ion events only (i) - intra track contribution of Δ-ray tracks (e) - inter track contribution of Δ-ray tracks (e-e) - ion-electron event contribution (i-e). The relative contributions are a function of radius x and of proton energy E. They have been separately calculated and the mean lineal energies have been derived from it. The results are intercompared with calculations based on track models with radial dose profiles.

24054 (EUR—9762-Vol.1, pp 265-274) **Calculated approach to the ionization of low-Z molecules by heavy charged particles.** Senger, B.; Rechenmann, R.V. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A double differential cross-section mixed treatment (DDCS-MT), developed in order to calculate double differential ionization cross-sections (DDCS), had allowed not only to reproduce with a good approximation Δ-ray yields measured in nuclear emulsions along 4- to 12-MeV α particle tracks, but also to interprete quantitatively experimental DDCS of atoms bombarded by heavy charged particles (HCP). It will be shown in this paper that the DDCS-MT can be extended to the case of molecules, like water and hydrocarbons, for ejection energies at least as low as approximatly 10 eV, provided that the binding energies of the molecular orbitals are taken into account, as well as the breaking up of these orbitals in therms of atomic orbitals. Very preliminary attempts to introduce the DDCS-MT in microdosimetric determinations will be mentioned, namely the assessment of the ionization energy loss distribution for protons bombarding water molecules, and of the probability of the number of ionizations produced in a small water sphere by incoming protons.

24055 (EUR—9762-Vol.2, pp 907-916) **Spectral neutron fluence and tissue kerma in collimated neutron beams from Be + d.** Brede, H.J.; Dietze, G.; Schlegel-Bickmann, D.; Kudo, K. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The neutron production of the Be - d reaction was studied for deuteron energies from 9.4 MeV to 13.3 MeV. Time-of-flight techniques and an NE 213 scintillator detector were used to determine the number, energy and angular distribution of the neutrons emitted from a thick Be target between 0^0 and 40^0 to the direction of the incident deuteron beam. By means of a Monte Carlo code the scattering of neutrons was calculated for different liner materials of a collimator. The influence of the neutron collimator on neutron fluence and standard tissue kerma at a distance of 80 cm from the Be target was evaluated.

24056 (IA—1421, pp 32) **Adjoint vs. forward solution of anisotropic transport problems.** Shayer, Z.; Greenspan, E. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.
In Research laboratories annual report 1985.

24057 **(INIS-mf—10253) Measuring the radial density distribution of light emission around the track of fast ions in nitrogen.** Ibach, T. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 1 Aug 1983. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87751341.

For analysing the emission and stopping of ionization electrons (σ-electrons) emitted by fast ions passing through a gas, the radial density distribution of the light emission of the (0,0) transition of two optical bands in nitrogen have been measured. The systems selected for the epxeriments are the 2nd positive system (2.PS) at 337.1 nm primarily excited by low-energy electrons of about 20 eV, and the first negative system (1.NS) at 391.4 nm excited by faster electrons and simultaneous ionization. The equipment developed for the experiments records the light emission with a telescope-type optical arrangement including interference filters, allowing high local resolution and dynamics of the measured range. The measurements have been carried out at pressures between 0.133 and 13.3 mbar, using photons of energies ranging from 270 keV to 2.8 MeV, helium 3 beams of 270 keV/u and 500 keV/u, and neon beams of 270 keV/u. Abel's inversion applied to the distance functions allows calculation of the spatial light emission density which is normalized for a gas density of 1 g/cm/sup 3/. The profiles of the two bands indicate that the σ-electron spectrum gets harder in outward direction. Next to the beam the impact density decreases faster with increasing ion energy than the stopping power (increasing interaction range of the σ-electrons). With photon beams, about half of the whole light emission in the 1. NS, and of the ionization, is induced by primary interactions of the ion beam. This proportion decreases at constant energy per nucleon with increasing atomic number of the ions as compared with the σ-electrons. The primary σ-emission gets harder with higher atomic numbers.

24058 **(INP—1232/AP) Influence of the thermal neutron energy distribution on results of pulsed measurements with small samples.** Drozdowicz, K. (Institute of Nuclear Physics, Krakow (Poland)). 1983. 151p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87701579.

An approach to the problem of the influence of the thermal neutron energy distribution on results of pulsed measurements from the point of view of bounded, small, two-region systems is presented. A model including the energy effects into the description of the decaying thermal neutron flux in bounded two-region systems is proposed. The consequences of neglecting the influence of the energy distribution are also shown.

24059 **Diffusion-synthetic method for acceleration of linear nodal S/sub n/ calculations.** Khalil, H. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 278-280(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Application of the differencing procedures devised by Alcouffe and Larsen to the diffusion-synthetic acceleration of multidimensional nodal S/sub n/ calculations yields difference equations that may not be efficiently solvable and has so far been accomplished only for the lowest order constant-constant (C-C) nodal scheme. An alternative differencing technique has been described in which the spatial approximations applied to the continuous diffusion operator are consistent in the P_1 limit with corresponding approximations made in deriving the nodal S/sub n/ equations. The effectiveness of this technique, which is applicable to any S/sub n/ method, has previously been demonstrated for the C-C and constant-linear (C-L) nodal schemes. Here the author extends the technique to the higher order linear nodal (LN) scheme and demonstrates that the diffusion difference equations obtained can be solved efficiently despite their increased complexity and that the resulting synthetic iteration procedure is stable and rapidly convergent. Very recently, Lawrence developed a different synthetic acceleration method based on an interface-current approach and also applied it successfully to the LN equations.

24060 **Vectorization of three-dimensional general-geometry Monte Carlo.** Brown, F.B. (Knolls Atomic Power Lab., Schenectady, NY). *Transactions of the American Nuclear Society;* **53**: 283-285(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

A three-dimensional general-geometry Monte Carlo code with continuous-energy physics and extensive tallying treatments has been vectorized. This code is in production use and provides speed-ups of at least 10 over a comparable scalar code. Performance results on the Cyber-205 computer are demonstrated with three-dimensional PWR calculations.

24061 **Low energy electron attenuation length studies in thin amorphous carbon films.** Martin, C.; Arakawa, E.T.; Callcott, T.A.; Ashley, J.C. (Oak Ridge National Lab., TN). *Journal of Electron Spectroscopy and Related Phenomena;* **35**: 307-317(1985). Contract AC05-84OR21400.

The results of experiments on low energy electrons passing through thin amorphous carbon films are reported. For electron energies between 50 and 3000 eV, electron attenuation lengths were determined by electron transmission measurements through carbon films of thicknesses between 81 and 210 A. The density of these amorphous carbon films was also obtained by a sink-float method and found to be 1.90 +/- 0.05 g cm^{-3}. The electron attenuation length for inelastic scattering was found to increase monotonically from approximately 10 to 55 A over the 50 to 3000 eV range. Over the 500-3000 eV energy region, the results are in good agreement with mean free paths calculated using optically measured dielectric functions. 18 references, 4 figures.

24062 **Implicit scheme for calculating time- and frequency-dependent flux limited radiation diffusion in one dimension.** Axelrod, T.S.; Dubois, P.F.; Rhoades, C.E. Jr. (Lawrence Livermore National Lab., CA). *Journal of Computational Physics;* **54**: No. 2, 205-220(May 1984). Contract W-7405-ENG-48.

A flexible and accurate method for solving nonlinear time- and frequency-dependent flux limited radiation diffusion and radiation-matter coupling problems in one dimension is developed. The method is based on converting the set of partial differential equations for the flux-limited multigroup diffusion approximation into a systems ordinary differential equations which are integrated by a generalized stiff equation solver. Unlike previous operator-splitting techniques which can introduce instabilities into the solution or which produce smooth but highly inaccurate solutions, this scheme provides a reliable accurate solution with reduced overall computation effort. The solutions describe both the streaming and diffusion limits of transport theory and are stable with time steps comparable to the changes in physical variables. 20 references, 5 figures.

24063 **Plasma energy deposition from the nuclear elastic scattering of tritons on tritons.** Devaney, J.J. (Los Alamos National Lab., NM). *Nuclear Science and Engineering;* **88**: 592-600(1984).

The rate of energy loss in a triton plasma suffered by tritons from nuclear forces elastic scattering plus nuclear Coulomb interference is calculated up to 3.5-MeV triton energy. 5 references, 1 figure, 1 table.

6550 Medical Physics

REFER ALSO TO CITATION(S) 23036, 23289, 23289, 23295, 23296, 23315, 23315, 23339, 23578, 23579, 23580, 23581, 23612, 23760

24064 (EUR—9762-Vol.1, pp 71-86) **Conceptual basis for neutron radiation protection.** Burger, G.; Morhart, A.; Wittmann, A. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The conceptual basis for neutron radiation protection has specific neutron aspect and general radiation protection aspects. As to the first, the rationale of q(L), q(Esub(n)) and finally the risk factors used in the definition of the effective dose equivalent, Hsub(E), are discussed. Using an approach developed by Rossi, an alternative q(L) is assumed and q(Esub(n)) and finally Hsub(E) calculated. General radiation protection aspects concern the definition, introduction and application of operational quantities, which are intended to replace in practice the primary and secondary limited ones. Neutron dose equivalent is not directly measurable, although efforts are now being made to utilize TE-proportional counters, and so at present all quantities have to be defined via calculated fluence-to-dose equivalent conversion functions. Extensive radiation transport calculations have been performed in the past in both anthropoid and regular body phantoms to determine fluence conversion factors for the whole hierarchy of primary limited and operational quantities. Quantities defined in the ICRU-sphere are of special interest. Revised data sets for all relevant quantities will be shown and intercompared. One of the recurrent problems in radiation protection is the difficulty in establishing a unique concept for environmental and individual monitoring. The planned concept of ICRU is critically reviewed in this respect. Finally the implications of the new proposals on the uncertainty in assessing limited quantities under certain exposure conditions in radiation protection practice will be discussed.

24065 (EUR—9762-Vol.1, pp 87-94) **Problems of a consistent assessment of the individual dose in mixed neutron-photon radiation fields.** Wagner, S.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The system of dose limitation as set by ICRP refers to two categories of quantities, effective dose equivalent, and mean dose equivalents in particular tissues or organs. As both categories of quantities cannot be measured easily, operational quantities of the

dimension of dose equivalent are introduced, which can be assessed by practical instruments. In area monitoring for neutrons this has to be a quantity defined in an anthropoid phantom. Another quantity serving the same purpose is the dose equivalent as produced at a specified depth in a 30 cm dia soft tissue sphere (ICRU sphere). Such area monitors are calibrated by exposing them to a well defined neutron field of known neutron flux density using fluence to dose equivalent conversion factors as given by ICRP, which take into account the dose equivalent contribution of the heavy charged particles produced by the neutrons as well as the contribution by the neutron capture gamma radiation arising in the phantom. The photon radiation present in a mixed radiation environment in absence of the phantom is assessed separately by an instrument which ideally doses not respond to neutrons. On the other hand, individual monitoring in mixed radiation fields is generally performed separately by photon responding and by neutron responding individual monitors worn on the trunk of the exposed individual. In this case, the photon monitor senses the contribution from the incoming photon radiation and the contribution by photons from neutron capture in the body. Hence it would not be consistent to calibrate the individual neutron monitor by using the same neutron fluence to dose equivalent conversion factors as with the area monitor. However, ICRP gives only the neutron fluence-to total dose equivalent conversion factors.

24066 (EUR—9762-Vol.1, pp 95-105) **Improved operational quantity for neutron radiation protection monitoring.** Siebert, B.R.L.; Hollnagel, R.; Jahr, R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The relation between operational and primarily limiting quantities is discussed on the basis of a procedure for calibrating individual dosemeters in which allowance is made for different directions of the incident radiation. Accepting Hsub(eff) as the primarily limiting quantity the suitability of H_{10} (dose equivalent on the principal axis of the ICRU sphere at a depth of 10 mm) or Hsub(sph) (weighted sum depth of dose equivalents in the ICRU sphere) as operational quantities for individual neutron monitoring is examined as a function of energy and direction of incidence of the radiation. It is concluded that Hsub(sph) appears to be suitable.

24067 (EUR—9762-Vol.1, pp 107-119) **New trends in the ICRU sphere.** Morstin, K.; Kawecka, B.; Booz, J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltfroschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A space transformation has been applied that enables the transport equation to be efficiently solved for spheres exposed to radiations of almost arbitrary angular distribution. Depth dose distributions in the ICRU sphere have been calculated with the 1-D ANISN transport code for neutron energies from thermal up to 20 MeV and for photons up to 15 MeV. Several irradiation geometries are considered. For deep-penetrating radiations, maximum possible dose equivalent index significantly exceeds Hsub(10) star.

24068 (EUR—9762-Vol.1, pp 123-132) **Estimation by means of albedo fluence calculations of the response of individual neutron dosemeters fixed to phantoms.** Hollnagel, R.; Jahr, R.; Siebert, B.R.L. (Institut fuer Strahlenschutz, Gesellschaft fuer Stranlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

No individual neutron dosemeter currently available can meet all of the requirements needed for satisfactory dose assessments. However, a combination of thermoluminescent albedo dosemeters and etched plastics (track detectors) seems to attract general interest. This paper presents calculations of the readings of such detectors for various exposure conditions. Albedo and track etch detectors attached to the ICRU sphere phantom are examined. The influence of the phantom on the reading is discussed and comparisons of the ICRU phantom and the anthropomorphic MIRD phantom are also presented.

24069 (EUR—9762-Vol.1, pp 133-145) **Neutron and photon fluence-to-dose conversion factors for active marrow of the skeleton.** Kerr, G.D.; Eckerman, K.E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Most estimates of absorbed dose in various organs of the body are derived from radiation transport calculations in anthropomorphic phantoms. The homogenized skeleton is adequate for radiation transport purposes since it provides correct scattering and absorption properties. However, the effects of the microstructure of bone must be considered in deriving realistic estimates of the absorbed dose in soft tissues of the skeleton, particularly the active (red) marrow which is one of the most radio sensitive tissues of the body. We have investigated the effects of the microstructure of bone on absorbed dose in active marrow for a variety of active marrow sites in the skeleton and a wide range of neutron and photon energies. These studies indicate clearly that the presence of bone alters the absorbed dose in active marrow from photons which energies less than several hundred keV and neutrons with energies greater than several MeV, but the results cannot be applied generally. We avoid the assumption of a special geometry by using measured chord-length distributions to represent the microstructure of the trabecular bones containing the active marrow (e.g., parietal bone, lumbar vertabra, cervical vertebra, iliac crest, rib, and both the head and neck of the femur). Results of our calculations for neutrons and photons with energies up to 20 MeV are provided as fluence-to-dose conversion factors, for application in radiation transport calculations of absorbed dose in active marrow from photons and neutrons extrenally incident on body, and photons produced by neutron interactions within the body. Our results suggest that the neutron and photon fluence-to-dose conversion factors for lumbar vertebra can be used as a representative example for all active marrow sits except those in parietal bone of the skull.

24070 (EUR—9762-Vol.1, pp 147-156) **Field measurements of neutron energy and angle spectral distribution and their interpretations in terms of relevant radiological protection quantities.** Bartlett, D.T.; Bardell, A.G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Measurements have been made of the neutron energy and angular distributions at eight and nine sites respectively in a nuclear facility. The energy spectral distributions were measured using the multisphere technique. The results have been used to calculate the response of a type 0075 survey meter and to compare values of the quantities ambient dose equivalent, effective dose equivalent and individual dose equivalent, penetrating.

24071 (EUR—9762-Vol.1, pp 157-168) **Neutron occupational exposure and radiological protection.** Wittmann, A.; Burger, G.; Kollerbaur, J.; Schraube, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

A set of 76 stray and leakage spectra of neutrons partly measured and partly theoretically assessed in nuclear reactor and accelerator environments have been compiled. 31 are indirectly determined by own multisphere measurements in the experimental hall of a swimming pool research reactor. For all spectra and several assumed exposure conditions (A-P and isotropic radiation inci-

dence) various quantities relevant in radiation protection have been determined. This concerns the effective dose equivalent, the newly recommended operational quantity H_{10}, as defined in the ICRU-sphere, and finally the expected reading of albedo dosemeters, some Bonner spheres and a standard Anderson and Braun rem counter.

24072 (EUR—9762-Vol.1, pp 171-181) **W-value measurements for protons in tissue-equivalent gas and its constituent gases.** Thomas, D.J.; Burke, M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Absolute measurements of W (the mean energy required to create an ion pair) have been performed for protons with energies between 1.2 MeV and 3.5 MeV for tissue-equivalent gas, and its constituent gases i.e. methane, carbon-dioxide, and nitrogen. The apparatus consisted essentially of two parallel plates enclosed within a vessel containing the gas of interest. Protons entered the measurement chamber through a thin Mylar window and were stopped in the gas region between the plates. A high voltage applied to one plate enabled the ion current to be measured from the opposite plate. The number of protons which produced the measured integrated charge was obtained simultaneously by amplifying signals from the high voltage plate and counting pulses resulting from individual protons. Results for W are somewhat lower than those suggested by ICRU Report 31. For tissue-equivalent gas there have been previous measurements in this energy region by Rohrig and Colvett, and by Larson, and the present measurements are about 2% lower.

24073 (EUR—9762-Vol.1, pp 193-201) **Measured neutron carbon kerma factors from 14.1 MeV to 18 MeV.** Deluca, P.M.; Barschall, H.H.; Haight, R.C.; McDonald, J.C. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

For A-150 tissue-equivalent plastic, the total neutron kerma is dominated by the hydrogen kerma. Tissue kerma is inferred with reasonable accuracy by normalization to the kerma factor ratio between tissue and A-150 plastic. Because of the close match in the hydrogen abundance in these materials, the principal uncertainty is due to the kerma factors of carbon and oxygen. We have measured carbon kerma factor values of 0.183 +- 0.015 10^{-8} cGy cm^2 and 0.210 +- 0.016 10^{-8}cGy cm^2 at 14.1-MeV and 15-MeV neutron energy, respectively. A preliminary value of 0.297 +- 0.03 10^{-8}cGy cm^2 has been determined at 17.9 MeV. A recent microscopic cross section measurement of the (n,n'3α) reaction in carbon at 14.1-MeV energy gives a kerma factor of 0.184 +- 0.019 10^{-8}cGy cm^2 in agreement with the present result.

24074 (EUR—9762-Vol.1, pp 203-212) **Determination of kerma in A-150 plastic for various neutron fields using three different methods.** Schlegel-Bickmann, D.; Dietze, G.; Guldbakke, S.; Buehler, G.; Schuhmacher, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The kerma in the tissue-equivalent material A-150 plastic was determined in monoenergetic neutron fields with neutron energies of 13.9, 15.0, 17.0 and 19.0 MeV and in a collimated neutron beam from Be + d (12.75 MeV) with a broad neutron energy distribution. Three different methods were used. The twin-detector method with a neutron-sensitive and a neutron-insensitive ionization chamber, and a single-detector method with a tissue-equivalent proportional counter were used to measure the photon and neutron kerma components in A-150 plastic. The third method was based on the determination of the spectral neutron fluence at the point of interest and the application of fluence to kerma conversion factors. With the kerma and the spectral neutron fluence data, kerma factors of A-150 plastic were determined. The measured kerma values agreed within 4.5% except for neutons at 19 MeV. At this energy the experimentally determined A-150 plastic kerma factor is about 11% less than the calculated value obtained from the literature. In the collimated neutron beam the kerma values determined by different methods agreed within 3.3%.

24075 (EUR—9762-Vol.1, pp 213-224) **Critical evaluation of neutron kerma factors using theoretical and experimental ionization yield spectra.** Schuhmacher, H.; Menzel, H.G.; Coyne, J.J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Ionization yield calculations were performed and compared to measurements for 13.9, 15.0, 17.0 and 19.0 MeV. The measured spectra were normalized to unit neutron fluence and the calculations take account of the neutron energy distributions at the detector positions. The computer code was tested by comparison with experimental data at 0.57, 2.07 and 5.25 MeV because physical data are well known at these energies. Total kerma for 19 MeV as well as kerma due to alpha-particles for 17.0 and 19.0 MeV are significantly lower for the measured data. There is clear evidence that the ^{12}C(n,n'3α) cross section for 17 and 19 MeV used in the calculations and in kerma evaluations is too high.

24076 (EUR—9762-Vol.1, pp 227-235) **Influence of neutron transport phenomena on kerma, absorbed dose and energy deposition spectra.** Booz, J.; Kawecka, B.; Morstin, K. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Transport of neutral primaries is frequently ignored in microdosimetric calculations, which is often bound to produce misleading results for deepseated points of interest. The paper briefly describes the application of combined Ssub(N) (for neutral primaries) and CSDA (for charged secondaries) transport calculations for evaluating correctly energy release and deposition in extended media exposed to neutrons. Calculations have been performed for the ICRU sphere and for some proportional counters, in a wide range of incident neutron energies. Results are compared with corresponding Monte Carlo calculations and with experimental event-size spectra. For most of the investigated cases, results are strongly influenced by primary transport effects. Thus, propagation of neutrons and the related gamma-ray production must not be neglected, neither when simulating responses of dosemeters and microdosimetric counters nor when evaluating radiation effects deep in tissue.

24077 (EUR—9762-Vol.1, pp 237-244) **Monte Carlo calculation of energy deposition and ionization yield for high energy protons.** Wilson, W.E.; McDonald, J.C.; Coyne, J.J.; Paretzke, H.G. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung mbH, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Recent calculations of event size spectra for neutrons use a continuous slowing down approximation model for the energy losses experienced by secondary charged particles (protons and alphas) and thus do not allow for straggling effects. Discrepancies between the calculations and experimental measurements are thought to be, in part, due to the neglect of straggling. A tractable way of including stochastics in radiation transport calculations is via the Monte Carlo method and a number of efforts directed toward simulating positive ion track structure have been initiated employing this technique. Recent results obtained with our updated and extended MOCA code for charged particle track structure are presented here. Major emphasis has been on calculating energy deposition and ionization yield spectra for recoil proton crossers

since they are the most prevalent event type at high energies (>99% at 14 MeV) for small volumes. Neutron event-size spectra can be obtained from them by numerical summing and folding techniques. Data for ionization yield spectra are presented for simulated recoil protons up to 20 MeV in sites of diameters 2-1000 nm.

24078 (EUR—9762-Vol.1, pp 255-263) **Recent improvements in neutron energy deposition calculations.** Caswell, R.S.; Coyne, J.J.; Gerstenberg, H.M. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

At higher neutron energies calculations using the analytic method yield microdosimetric spectra in which the proton peak is narrower and shifted in peak energy when compared to experiment. This difference is usually attributed to the neglect of straggling in the calculation. In order to extend our calculational capability to this situation, we have written a Monte Carlo neutron energy deposition code which includes straggling of the energy depositions by charged particles in the sensitive volume. As a first consistency check, Monte Carlo calculations without straggling have been compared with the analytic method, and found to agree within the statistics of the Monte Carlo program. For thin sensitive volumes for which the Landau distribution should be appropriate, we are using the Monte Carlo code to calculate lineal energy (y) distributions with proton straggling included for energies up to 15 MeV. Comparisons to experiment will be made of the Monte Carlo method with straggling and the analytic method without straggling. One of the most interesting by products of this work is that it has shown us a relatively simple way to include Landau straggling in the analytic calculational method, greatly increasing the power of that method. We are now programming the inclusion of straggling into the analytic method code.

24079 (EUR—9762-Vol.1, pp 437-446) **Studies of dose as a function of depth in water-filled phantoms exposed around the CERN accelerators.** Fasso, A.; Gaborit, J.C.; Hofert, M.; Marchal, H.; Stevenson, G.R. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

In order to confirm the appropriateness of the quantity H_{10} for assessing dose equivalent in the stray radiation fields around the multi-GeV proton accelerators of CERN, a series of experiments were undertaken in which thermoluminescent dosimeters (LiF TLD-700) were exposed in water-filled phantoms. Attempts were made to separate the dose from high-LET components of the field by reading separately the different peaks in the thermoluminescent response curve of the TLD. In general, the results confirm the theoretical predictions that the dose equivalent is a maximum at or near the surface of the phantom, and that the dose equivalent at a depth of 10 mm is a suitable quantity for assessing radiological hazards in the experimental areas and outside the shielding of high-energy proton accelerators.

24080 (EUR—9762-Vol.1, pp 447-457) **Neutron depth dose calculations and measurements in an elliptical phantom for radiation protection purposes.** Palfalvi, J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The measurements of the radiation field in a phantom, with regard to the neutron component and the contaminating gamma-radiation, are essential for radiation protection and radio-therapy purposes. Depth-dose and neutron spectrum measurements and calculations have been carried out using an elliptical, water-filled phantom for total-body exposures from large neutron sources with long Source to phantom Surface Distances (SSD)s to simulate broad parallel beams of from point like sources with different SSDs as well as using collimated neutron beams of various field sizes. The calculations were performed by Monte Carlo codes; for the measurements, activation, thermoluminescent (TL) and solid state nuclear track detectors were used. Although the details of the mathematical and measuring procedures have been published earlier, they are summarized in form of a flowchart. The results of the 4 years long work are briefly outlined and illustrated by plots and tables.

24081 (EUR—9762-Vol.1, pp 553-561) **Multisphere spectrometry of the neutron field due to a D_2O moderated ^{252}Cf-source in a calibration room.** Harrison, K.G.; Hunt, J.B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Measurements are reported of the variation of multisphere count-rates as a function of distance from a D_2O moderated californium spontaneous-fission neutron source in a large calibration room. The measurements have been analysed to give the relative contributions in dose-equivalent rate at different distances due to the unscattered source neutrons and the inscattered neutrons. Further analysis of the count-rate data indicates that the source spectrum may be significantly different from published calculations.

24082 (EUR—9762-Vol.1, pp 563-574) **Spectral analysis of some fission neutron sources with the SOHO code from Bonner sphere data.** Zaborowski, H.L. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. (In French). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

For several tests fission neutron sources particularly ^{252}Cf bare and D_2O moderated, we present some spectral analysis results obtained with the new iterative code SOHO from BONNER spheres data. The approximative solutions are obtained upon discretization of the Fredholm equation of the first kind whose Resolution Function is experimentally known and mathematically defined by the Log-Normal Hypothesis given in our previous reports CEA-N-2241 (1981) and CEA-R-5181 (1982). The iterative procedure solve systems of non-exact homogeneous linear equations QX = e (by optimum liquidation of the residuals esub(i)) with positivity constraint and absolute convergence, leading to an appropriate physical solution with a relative error in our tests typically of the order of a fraction of one percent for the INPUT - OUTPUT Data. For the applications to Health Physics the SOHO Code has been programmed for use with a HP-41 CV calculator.

24083 (EUR—9762-Vol.1, pp 575-582) **Measurement of the neutron source strength ratio of the D_2O-moderated ^{252}Cf-source to that of the bare ^{252}Cf-source.** Hunt, J.B.; Kluge, H.; Rasp, W. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The D_2O-moderated californium spontaneous fission source consists of a 30 cm^2 diameter spherical stainless steel tank filled with heavy water (D_2O), and covered with a cadmium shell to prevent thermal neutrons leaking from the assembly. The physically small bare californium source is positioned at the sphere centre. In order to calibrate neutron personnel dosemeters using this source, knowledge of both its neutron spectrum and its neutron emission rate is required in order to calculate the dose equivalent rate at the irradiation position. The leakage spectrum has been calculated, using Monte Carlo techniques by Ing and Cross, down to 1 eV. Eisenhauer has estimated the spectrum from the cadmium cut-off energy up to 1 eV. Although it is relatively simple to absolutely calibrate the emission rate of a bare californium source, it is practically impossible to use any of the conventional techniques for the moderated source. An obvious way to obtain the emission rate of

such a source is to know the ratio of the bare to moderated source emission rates. A series of measurements, made at both institutes, have been made in order to determine this source emission rate ratio. The final evaluated result of (0.918 +- 0.027) is slightly higher than the value of 0.885 predicted by the Monte Carlo calculations.

24084 (EUR—9762-Vol.1, pp 597-606) **Monoenergetic neutrons of energies from 0.5 keV to 40 keV via the reaction $^{45}Sc(p,n)^{45}Ti$.** Cosack, M.; Lesiecki, H.; Hunt, J.B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The reaction $^{45}Sc(p,n)^{45}Ti$ has been investigated for the production of monoenergetic neutrons in the low keV region. The cross section of the reaction has several isolated, narrow resonances (line width less than 0.5 keV), which makes it possible to produce monoenergetic neutrons from 0.5 keV to 40 KeV. This source was found to be suitable for calibrating radiation protection instrumentation.

24085 (EUR—9762-Vol.1, pp 607-616) **Calibration of neutron survey meters over the energy range from 1 to 30 keV with accelerator produced monoenergetic neutrons.** Hunt, J.B.; Cosack, M.; Lesiecki, H. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The $^{45}Sc(p,n)^{45}Ti$ reaction has been used to calibrate two commercially available, portable neutron dose equivalent meters over the neutron energy range from 1 to 27 keV. These devices always over-respond in this energy range. The measured fluence rate responses and the calculated over responses for both a spherical and a cylindrical survey meter as a function of neutron energy are given, and compared with the few previously published results.

24086 (EUR—9762-Vol.1, pp 617-628) **Investigation of room scattered neutrons and their importance for the calibration of albedo dosemeters.** Singh, D.; Piesch, E.; Burgkhardt, B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen- und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

In routine monitoring the energy response of personnel dosemeters is such that there is a need for a more or less sophisticated field calibration of dosemeters in each stray neutron field. Survey meters used as a reference for the actual dose equivalent as well as albedo dosemeters are highly energy dependent and therefore sensitive to room scattered neutrons. In contrast to the standard calibration technique with the aim of scatter free calibration conditions, the field calibration has to take into account the total dosemeter reading and the actual dose equivalent without subtracting the contribution of room return neutrons. For the purpose of field calibrations the scattered neutron component has been investigated in the environment of a Cf-252 neutron source as a function of source distance and at different heights above floor using the Anderson-Braun counter, the 30 cm polyethylene sphere and albedo neutron dosemeters. Differences in estimating the source detector constant using the shadow-cone method and the semi-empirical method recommended by Eisenhauer and Schwartz are explained by detector characteristic effects. On the basis of experimental results the paper discusses the room scattered component of the detector reading, the differences in calibration factors derived from standard, routine and field calibrations as well as the general aspects of field calibration in personnel monitoring.

24087 (EUR—9762-Vol.1, pp 629-636) **Comparison of the filtered-neutron beams at the NBS and PTB reactors by calibrating a spherical rem meter.** Alberts, W.G.; Schwartz, R.B. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Two filtered-neutron beam facilities at the NBS and at the PTB providing quasi-monoenergetic beams of 2 keV, 24.5 keV and 144 keV are in use for radiation protection instrument calibration. Measurements are described which were performed to investigate the properties, and compare the calibrations, of these beams at both installations. A 20.8 cm diameter spherical rem counter and an 11 cm diameter sphere served as transfer instruments. The neutron current in the beams was determined with the respective methods in use at either facility. A filter-difference method was used to determine the contribution of high-energy neutron contamination to the count rate of the instruments. The responses of the instruments to the quasi-monoenergetic neutrons at both institutes are compared.

24088 (EUR—9762-Vol.1, pp 637-640) **Status of filtered neutron beam studies.** Harvey, J.R.; Mill, A.J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751063. (CONF-8409161—Vol.1).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Studies in the field of filtered neutron beams undertaken prior to 1981 are briefly reviewed. Since 1981 the uranium filter has been studied in more detail and calculations have been made which relate to boron-neutron capture therapy. Further published work has confirmed theoretical predictions of the cross sections of various single isotopes which could be used as low energy neutron filters. A meeting of specialists in 1983 confirmed an interest in filtered neutron beams in many disciplines and recommended that a working party be set up to identify and promote developments in the field.

24089 (EUR—9762-Vol.2, pp 1061-1071) **Total absorbed dose variations in different phantom materials of different neutron beam qualities.** Vynckier, S.; Mijnheer, B.J.; Rassow, J. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Percentage depth-dose data and output factors were studied for different phantom materials and different neutron beam qualities. In order to correct percentage depth-dose data from one phantom material to another, experimental and theoretical scaling factors (SF) are compared for different neutron beam qualities. The theoretical scaling factors are based on mean free path calculations and carried out at Fermilab, while the experimental scaling factors were collected from different European neutron therapy centers by means of a questionnaire. When comparing both scaling factors, for different phantom materials relative to water, diffences up to 10% were observed. In order to investigate these differences, SF/rho has been studied as a function of the H-concentration by mass, with rho being the mass density of the phantom material. It can be concluded that due to the uncertainty in the average total cross-sections of C and O experimental scaling factors will be more accurate than calculated values. A comparison of the absolute value of the absorbed dose at calibration depth (5cm) in a particular material relative to water shows a nearly linear variation with neutron energy. Determination of the output factor using these data and percentage depth-dose data yielded differences for polystyrene and TE-liquid which varied less than 3% for neutron beam qualities varying between d(14) + Be and p(65) + Be.

24090 (EUR—9762-Vol.2, pp 1087-1096) **Effect of using air in tissue-equivalent ionization chambers for the measurement of fast neutron absorbed dose distributions in phantoms.** Parnell, C.J.; Page, B.C.; Vynckier, S. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Dosimetry of fast neutron beams is undertaken most frequently with tissue-equivalent ionisation chambers filled with tissue-equivalent gas. However, measurements of absorbed dose distributions in a phantom are frequently carried out with air instead of tissue-equivalent gas. Under these conditions the signal from the air-filled chamber relative to that from a chamber filled with tissue-equivalent gas varies with chamber volume, field size, depth in the phantom and neutron beam energy. Consequently isodose distributions measured with air-filled chambers could be in error. For example, with the dose normalised at 5 cm deep, the use of a 0.1 cc chamber would underestimate the surface dose by 1% and overestimate doses at greater depths by up to 1% for a d(16)+Be beam. Larger errors occur for larger chambers but the errors decrease with increasing beam energy. It is suggested that the errors are due to variations in neutron interactions in the gas particularly at low energies.

24091 (EUR—9762-Vol.2, pp 1107-1118) **Neutron-beam depth-dose dosimetry and spectrometry in water phantom using SSNTDS and multigroup transport calculations.** Petoussi, N.; Durrani, S.A.; Fremlin, J.H.; Mast, H.U. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

The aim of our work is to investigate the production and energy transfer of charged particles produced by fast-neutron interactions with tissue equivalent materials. For that purpose, we have used two different approaches: an experimental one, using Solid State Nuclear Track Detectors (SSNTDs) and a theoretical one using multigroup transport calculations. For the experiments, the set-up of Hammersmith Hospital, London, was utilized which is currently used for neutron radiotherapy treatment. The polymeric SSNTDs (CR 39, LR 115 and Lexan) were mounted in different positions, both on and off the beam axis and at various depths, in a cubic water phantom. The track densities, produced in each type of detector through the interactions of neutrons with the constituents of both water and plastics themselves were measured. Using a MORSE-H Monte Carlo code, in conjunction with a 46 group cross-section library, the energy-dependent and -independent neutron fluences were calculated at various positions within the above phantom. This was done by simulating all the important details of the experiment. From the neutron spectrum and the response functions taken from the same library, the numbers of (n,p), (n,α) and H and O elastic-scattering reactions as well as the dose delivered by each of charged particles were calculated. The two methods were compared and found to be in good mutual agreement.

24092 (EUR—9762-Vol.2, pp 1227-1235) **International fluence rate intercomparison for 2.5, 5.0 and 14 MeV neutrons.** Liskien, H.; Lewis, V.E. (Institut fuer Strahlenschutz, Gesellschaft fuer Strahlen-und Umweltforschung, Muenchen, Germany, F.R.). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751120. (CONF-8409161—Vol.2).

From 5. symposium on neutron dosimetry; Munich, F.R. Germany (17 Sep 1984).

Fluence determinations for 2.5, 5.0 and 14 MeV neutrons as performed in standard laboratories have been compared. Two methods of intercomparison were used: One is based on the determination of a γ-rate ratio between ^{118}Insup(m) as induced by fast neutrons in an indium sample on one hand and ^{15}Cr from a calibrated source on the other hand and is used at all energies. The second method is restricted to 14 - 15 MeV neutrons and is based on measuring the ^{92}Nbsup(m) γ-activity induced in a niobium sample. Results show that the uncertainty contribution from the transfer methods does not essentially increase the overall uncertainty and that there is generally consistency.

24093 **(IAN-SR—9) Radiological security for industrial radiography.** Montoya G, M. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seguridad Radiologica). Apr 1985. 61p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87701519.

This report comprises the basic notions of nucleonics, simple calculations for point sources, X-rays, calculations for coatings, standards for radiation protection and industrial radiography instruments. The preceding sums up with the biological effects of ionizing radiation. This is a guide for people who wish to pass examinations, to get the license for radiological safety, for operators on gamma-graphic sources, which work in the country. It is a requirement for work with this kind of radioactive sources.

24094 (INIS-mf—10581, pp 168-170) **Dose equivalent distributions in the AAEC total body nitrogen facility.** Allen, B.J.; Bailey, G.M.; McGregor, B.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

The incident neutron dose equivalent in the AAEC total body nitrogen facility is measured by a calibrated remmeter. Dose equivalent rates and distributions are calculated by Monte Carlo techniques which take account of the secondary neutron flux from the collimator. Experiment and calculation are found to be in satisfactory agreement. The effective dose equivalent per exposure is determined by weighting organ doses, and the potential detriment per exposure is calculated from ICRP risk factors.

24095 **(SIS—1986:8) Natural radioactivity and cancer risk.** Baarli, J. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 26p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750901.

The report is a review of physical and biological parameters important in the calculation of the risk for cancer induction by natural radioactivity. Based on cited assumptions, natural radioactivity may cause 375 to 530 cases of cancer in Norway per year.

24096 **Code system to compute radiation dose in human phantoms.** Ryman, J.C.; Cristy, M.; Eckerman, K.F.; Davis, J.L.; Tang, J.S.; Kerr, G.D. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **53**: 37-38(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Data derived from radiation transport calculations in a mathematical model of the body are widely used for organ dose estimation in nuclear medicine and radiation protection. The Monte Carlo photon transport code ALGAM and a code using Monte Carlo integration of a point kernel, developed at Oak Ridge National Laboratory (ORNL) in the late 1960s, have been the source of dosimetric data used worldwide. These codes have been revised to incorporate human phantom models for an adult female, juveniles of various ages, and a pregnant female at the end of the first trimester of pregnancy, in addition to the adult male used in the earlier codes. An analysis code has been developed for deriving recommended values of specific absorbed fractions of photon energy. This paper describes the computer code system and calculations methods developed at ORNL, with emphasis on recent improvements in the methods.

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REFER ALSO TO CITATION(S) 22817, 22836, 23241, 23379, 23791, 23813, 23815, 23820, 23973, 23975, 24143

24097 (AD-A—175841/6/XAB) X-ray flash crystallography to study directed energy transfer in materials. Technical report, 9 July 1985-9 May 1986. Hailey, C.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 19 May 1986. 86p. NTIS, PC A05/MF A01.

This report describes both theoretical, computational and experimental efforts to develop a technique called x-ray flash crystallography (XRFC). In XRFC, time-dependent x-ray diffraction from a crystal is monitored before, during, and after the arrival of an intense, short-pulse-length infrared (IR) laser beam. The IR beam rapidly heats the crystal to high temperature. This induces temperature-dependent changes in the crystals form factor which change the x-ray reflectivity of the crystal; this is just the well-known Debye Waller effect. The temperature-sensitive effects are incorporated into a model used to predict the change in x-ray reflectivity as a function of temperature; the temperature rise itself is determined by a knowledge of the energy-deposition profile, and perhaps the dynamics of the lattice heating. This model then allows the extraction of the time-dependent temperature from the time-dependent x ray reflectivity which is measured. Using x-rays as the probe, rather than an optical probe, ensures that the temperature measured is truly that of lattice. It also avoids contamination of the data due to electron-hole plasma related changes in the optical reflectivity.

24098 (CONF-861247—2) Simulation of the roughness of the border of a molecule. Ramirez, R.; Schneider, M.; Rahman, A.; Schuller, I.K. (Universidad Catolica de Chile, Santiago. Facultad de Fisica; Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 8p. (In Spanish). NTIS MF A01; 2; GPO Dep. File Number DE87007044.

From 5. simposio Chiceno de Fisica; Santiago, Chile (18 Dec 1986).

We have solved, using molecular dynamics techniques, a model which consists of a 487-particle movable overlayer on an infinite rigid substrate. The interaction J_1 between the boundary and interior atoms of the overlayer is weaker than those between interior atoms. We have found that the roughness of the border of the overlayer increases with increasing temperature and with decreasing J_1, contrary to the interpretation of Kolaczkiewicz and Bauer of their experiment of an overlayer of Au on a W substrate. We also argue that the Kolaczkiewicz-Bauer claim that their experimental setup is a realization of the Abraham model for the 2D ferromagnetic Ising model, has to be revised.

24099 (CONF-870155—2) Energy loss and scattering of subexcitation electrons in SiO_2. Ashley, J.C.; Ritchie, R.H.; Crawford, O.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006619.

From 10. Werner Bradt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

For electrons with energies below the band gap energy of ~ 9 eV in SiO_2, energy loss or gain occurs through phonon emission or absorption. Coupling to the longitudinal optical (LO) modes has been considered by several workers in connection with "electron-runaway" and subsequent "breakdown" when high electric fields are applied to this insulator. The important role played by acoustic phonon modes in predicting the breakdown field in SiO_2 was recently discussed by Fischetti and Fischetti, et al. following the theoretical formulations described by Sparks, et al. We have re-examined these interactions and evaluated the energy loss per unit pathlength and transport mean free path to aid in a qualitative description of the behavior of subexcitation electrons in SiO_2. For example, energy losses and angular deflections experienced by subexcitation electrons in matter are very important in establishing whether geminate recombination occurs between an ejected electron and its parent ion in radiation physics. The response of solid-state devices to ionizing radiation is determined in part by recombination processes, which in turn may depend importantly on the kinds of cross sections that we consider here. 11 refs., 6 figs.

24100 (CONF-870224—3) Cluster emission from a molybdenum surface. Husinsky, W.; Pellin, M.; Calaway, W.; Burnett, J.; Schweitzer, E.; Young, C.; Gruen, D. (Argonne National Lab., IL (USA)). 16 Feb 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006989.

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

Yields of neutral and ionized Mo clusters emitted from a Mo surface during ion beam bombardment have been measured. Yields of neutral Mo_2 and Mo_3 were obtained using resonance and nonresonance ionization spectroscopy. The yields of ionized atoms and clusters were obtained by SIMS.

24101 (IC—86/149) Instabilities in the microwave GaAs-IMPATT diode amplifiers. Seddik, M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701520.

Instabilities of the IMPATT diode amplifiers under large signal drive are investigated both theoretically and experimentally. Parametric oscillations observed at the subharmonics and the power limitations during the operation of the diode as an amplifier are explained. The method of monitoring the parametric oscillations is discussed. The non linear properties of the avalanche process of the GaAs IMPATT diode is used for parametric amplifications. The gain of the frequency conversion and its relation to the pumping level is considered. A Read-Type GaAs diode is examined at X-band frequencies in a microwave reflection amplifier. 3 refs, 1 fig.

24102 (IC—86/150) Unconditionally stable microwave Si-IMPATT amplifiers. Seddik, M.M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701521.

The purpose of this investigation has been the development of an improved understanding of the design and analysis of microwave reflection amplifiers employing the negative resistance property of the IMPATT devices. Unconditionally stable amplifier circuit using a Silicon IMPATT diode is designed. The problems associated with the design procedures and the stability criterion are discussed. A computer program is developed to perform the computations. The stable characteristics of a reflection-type Si-IMPATT amplifier, such as gain, frequency and bandwidth are examined. It was found that at large signal drive levels, 7 dB gain with bandwidth of 800 MHz at 22,5 mA was obtained. 9 refs, 2 figs.

24103 (IC—86/187) Diffusion-limited aggregation with long range force. Huang Yun; Lu Jiagang; Wang Liangyu; Zhao Huimin. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701533.

The Diffusion-limited aggregation model with long range force is investigated. Single particles are moved under the control of Brownian motion and drift motion produced by regular centrical long range force. The computer simulations under this condition have been studied in detail in two-dimension and the results are compared with properly electrolytic deposition experiments. 5 refs, 5 figs, 1 tab.

24104 (IC—86/197) Orbital removal method for the neutral vacancy in semiconductors. Bashenov, V.K.; Kardashev, D.L.; Marvakov, D.I. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701537.

A study of the orbital removal method for vacancy states in semiconductors is presented. It is shown that the bound and resonance states are zeroes of the local perfect-crystal Green function. We suggest that the generalized localized orbitals generate a vacancy potential, when the atom has been removed from the lattice site, which leads to the appearance of a bound state. This is demonstrated for diamond. 8 refs, 1 fig.

24105 **(IC—86/203) Temperature and pressure dependent osmotic pressure in liquid sodium-cesium alloys.** Rashid, R.I.M.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701542.

The evaluation of the osmotic pressure in terms of the concentration fluctuations of mixtures and the equations of state of the pure liquids is considered. The temperature and pressure dependent experimentally measured concentration-concentration correlations in the long wavelength limit of liquid sodium-cesium alloys are used to demonstrate the appreciable dependence of the temperature and pressure on the osmotic pressure as a function of concentration. Introducing interchange energies as functions of temperature and pressure, our analysis is consistent with the Flory model. Thus, a formalism for evaluating the state dependent osmotic pressure is developed and our numerical work is considered to be an extension of the calculations of Rashid and March in the sense that a temperature and pressure dependent interchange energy parameter that more closely parameterizes the state dependent concentration fluctuations in the liquid alloys, is used. 15 refs, 2 figs.

24106 **(IC—86/208) Effect of asymmetry on resonant tunneling.** Garcia-Calderon, G. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701544.

Resonant tunneling experiments on multibarrier coupled heterostructures probe the quasistationary nature of the states of the corresponding one dimensional potential. This work considers the effect of asymmetric one dimensional multibarrier potentials on resonant tunneling. It is shown, by using the properties of the propagator of the system, that this effect may lead to novel resonance phenomena and affects the lifetime of the quasistationary states of the system. The above considerations are illustrated by a simple analytical solvable model. 7 refs.

24107 **(IC—86/223) Three-dimensional semi-infinite spin-1/2 Ising model in a random field.** Saber, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701547.

All the possible phase diagrams of a three-dimensional semi-infinite spin-1/2 Ising model in a random field as a function of the ratio of bulk and surface interactions and the ratio of bulk and surface fields have been determined. Within the framework of the mean-field approximation eight generic types of phase diagrams can be found. It is also found that such a system can exhibit a variety of phase transitions and multi-critical points. 21 refs, 7 figs.

24108 **(IC—86/234) Liquid structure and freezing of metals and salts.** Tosi, M.; Rovere, M.; D'Aguanno, B. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701549.

We briefly review recent developments in the density-wave theory of the liquid-solid transition. Various examples are given of the evaluation of phase diagrams for models relevant to pure metals, mixtures and salts based on alternative approaches to the construction of the free energy of a hot crystal from properties of its liquid. Phenomenological connections between liquid structure and hot-solid properties in superionic and glass-forming salts are also discussed. 46 refs, 2 tabs.

24109 **(IC—86/236) Electron spin-lattice relaxation in fractals.** Shrivastava, K.N. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701550.

We have developed the theory of the spin-fracton interaction for paramagnetic ions in fractal structures. The interaction is exponentially damped by the self-similarity length of the fractal and by the range dimensionality d/sub PHI/. The relaxation time of the spin due to the absorption and emission of the fracton has been calculated for a general dimensionality called the Raman dimensionality d/sub R/, which for the fractons differs from the Hausdorff (fractal) dimensionality, D, as well as from the Euclidean dimensionality, d. The exponent of the energy level separation in the relaxation rate varies with d/sub R/d/sub PHI//D. We have calculated the spin relaxation rate due to a new type of Raman process in which one fracton is absorbed to affect a spin transition from one electronic level to another and later another fracton is emitted along with a spin transition such that the difference in the energies of the two fractons is equal to the electronic energy level separation. The temperature and the dimensionality dependence of such a process has been found in several approximations. In one of the approximations where the van Vleck relaxation rate for a spin in a crystal is known to vary with temperature as T/sup 9/, our calculated variation for fractals turns out to be T/sup 6.6/, whereas the experimental value for Fe/sup 3+/ in frozen solutions of myoglobin azide is T/sup 6.3/. Since we used d/sub R/=4/3 and the fracton range dimensionality d/sub PHI/=D/1.8, we expect to measure the dimensionalities of the problem by measuring the temperature dependence of the relaxation times. We have also calculated the shift of the paramagnetic resonance transition for a spin in a fractal for general dimensionalities. 29 refs.

24110 (INIS-mf—10581, pp 19-21) **Depth profiles of H and O in thin films of a-Si:H.** Sie, S.H.; Ryan, C.J.; McKenzie, D.R.; Smith, G.B. (Commonwealth Scientific and Industrial Research Organization, North Ryde, Australia. Div. of Mineral Physics; Sydney Univ., Australia. School of Physics; New South Wales Inst. of Tech., Broadway, Australia). Nov 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE87701623. (CONF-851194—).

From 4. nuclear techniques of analysis conference; Lucas Heights, Australia (6 Nov 1985).

Detailed depth profiles of hydrogen and oxygen were measured, in thin film samples of a-Si:H produced under varying conditions, using the reaction /sup 1/H(/sup 19/F,$\alpha\ \gamma$)/sup 16/O in the vicinity of the resonance at E(/sup 19/F) = 6.417 MeV to profile hydrogen, and resonant elastic α scattering near the resonance at Eα = 3.0359 MeV to profile oxygen. Contrasting results reflecting the different fabrication conditions were obtained and these were correlated with the measured electrical properties.

24111 (INIS-mf—10589, pp 60) **Hyperfine magnetic fields on Sm nuclei in iron and nickel.** Budzynski, M.; Simecek, P.; Lesner, T.; Cizek, P.; Prochazka, I.; Simeckova, E.; Tsupko-Sitnikov, V.M.; Ehn, L.; Janout, Z. (Uniwersytet Marii Curie-Sklodowskiej, Lublin, Poland; Joint Inst. for Nuclear Research, Dubna, USSR; Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24112 (INIS-mf—10589, pp 67-68) **Possible /sup 252/Cf utilization in mass spectrometry.** Kliman, J.; Duka-Zolyomi, A. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Fyzikalny Ustav; Komenskeho Univ., Bratislava, Czechoslovakia. Matematicko-Fyzikalna Fakulta). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24113 (INIS-SU—401, pp 23-26) **Study of gadolinium-scandium-gallium garnet monocrystals by the Mandelstam-Brillouin light scattering method.** Zharikov, E.V.; Kitaeva, V.F.; Kosheleva, I.V.; Ershova, L.M.; Kalitin, S.P.; Osiko, V.V.; Sobolev, N.N. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

Gadolinium-scandium-gallium garnet monocrystals are studied by the Mandelstan-Brillouir light scattering method. Elastic and photoelastic properties are determined, characteristic peculiarities of light scattering in these crystals are found out.

24114 **(LBL—22608) Alloy phase stability.** de Fontaine, D. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 25p. (CONF-8610258—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007166.

From International school on electronic band structure; Kanpur, India (20 Oct 1986).

The calculation of phase diagrams from first principles constitutes a critical test of accuracy of both quantum and statistical mechanical models. The slightest variation of calculated energies can result in drastic changes in the topology of phase diagrams: the location of phase boundaries and even the nature of the phases in mutual equilibrium is determined by the common tangent construction so that small alterations in the shape or relative positions of free energy curves can cause common tangents to connect completely different sets of phases, structures, and concentrations. In other words, phase diagrams result from "non-local minimization:" all possible free energy curves of all possible phases must be considered, at all concentrations, and compared to one another. Only "prototype" systems were considered. The tight binding CPA was used as basic quantum mechanical framework, and the CVM was used for the statistical mechanical calculations.

24115 **(NORDITA—85/14-Prepr.) Current fluctuations in sliding charge density waves.** Ritala, R.K.; Hertz, J.A. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Apr 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751248.

Inhomogeneous dynamical fluctuations are shown to dominate at the onset of sliding motion of charge density waves in any finite dimensionality d. A self-consistent calculation leads to critical exponents different from those of the infinite-range model. There is a crossover to the infinite-range exponents farther away from the threshold; the region where the new exponents hold shrinks and disappears in the limit d->∞.

24116 **(SAND—87-0261C) Molecular dynamics simulation of beam deposition of low-energy (10-100 eV) Si atoms on the Si(111) surface.** Dodson, B.W.; Taylor, P.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 26p. (CONF-870385—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006131.

From SPIE conference on growth of compound semiconductors; Bay Point, FL, USA (22 Mar 1987).

The deposition of low energy (10 to 100 eV) silicon atoms onto an unreconstructed (111) silicon surface has been studied using molecular dynamics techniques and an accurate empirical potential describing the covalent Si-Si bonding. 10 eV silicon atoms were directed normal and at 60° angles to a silicon (111) substrate. The resulting atomic trajectories and substrate response were studied to determine the energy loss mechanism resulting in capture and the local lattice excitation near and subsequent diffusion of excess vibrational energy away from the impact point. More glancing angles of incidence (5 to 30°) were studied for beam energies of 20 to 100 eV. 6 refs.

24117 **(SAND—87-0358C) Molecular-dynamics simulation of low-energy beam deposition of silicon.** Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 27p. (CONF-870224—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006132.

From 2. topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (16 Feb 1987).

The mechanisms controlling low energy (10-100 eV) beam deposition of silicon onto a relaxed (111) silicon substrate have been studied using a molecular dynamics technique. The atomic interaction was modeled using a many body empirical potential so that the effects of the covalent Si-Si bonding could be accurately included. 10 eV silicon atoms with near-perpendicular incidence were studied to determine the energy loss mechanism resulting in capture and the local lattice excitation near and subsequent diffusion of excess vibrational energy away from the impact point. Shallower angles of incidence (5°-30°) were studied for beam energies of 20-100 eV. For incidence angles less than an energy- and orientation-dependent critical value, a new phenomenon of 'surface channeling' is observed, in which the trajectory of the incoming particle is steered parallel to, and roughly 2 A above, the surface of the substrate by inelastic interaction with the surface atoms. 11 refs., 5 figs.

24118 **(UCRL—95038) Soft x-ray generation by the Cherenkov effect.** Moran, M.J.; Chang, B. (Lawrence Livermore National Lab., CA (USA)). 25 Feb 1987. Contract W-7405-ENG-48. 20p. (CONF-870155—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006241.

From 10. Werner Bradt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter; Alicante, Spain (7 Jan 1987).

The Cherenkov effect may be used to generate coherent soft x rays by taking advantage of the dielectric constants of materials in the neighborhood of atomic resonances. The Cherenkov effect usually is not possible for x rays because the refractive index is less than one for most x-ray frequencies. However, for narrow frequency bands near atomic resonances, the refractive index can exceed unity with values large enough to generate coherent x rays with efficiencies higher than any other electron-driven technique. The basic physics of the process is discussed and is used to make rough estimates of photon production efficiencies. An exact theoretical description of Cherenkov production in thin foils is used together with recently-measured refractive indices to calculate the emission distributions of 100 eV photons from thin silicon foils. These distributions are found to be roughly consistent with the simple estimates. In addition, unusual behavior by the distributions suggests a technique that can be used to increase dramatically the peak angular intensities. 15 refs., 10 figs.

24119 **Multipolar response of small metallic spheres: Nonlocal theory.** Fuchs, R.; Claro, F. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 8, 3722-3727(15 Mar 1987). Contract W-7405-ENG-82.

The multipolar response of a small metallic sphere is studied with use of a nonlocal dielectric function. Results obtained with the hydrodynamic and Lindhard-Mermin models are presented and compared to those given by the local Drude model. We find an enhancement of the imaginary part of the multipole polarizabilities at low frequencies and pole order l<l/sub c/, where l/sub c/ is a cutoff order that corresponds to excitations at the high-wave-vector edge of the electron-hole pair continuum. The absorption coefficient for two very close spheres is calculated and the effect of nonlocality on the number and position of the multipolar absorption peaks is discussed.

24120 **Relationship between specific surface area and spatial correlation functions for anisotropic porous media.** Berryman, J.G. (Lawrence Livermore National Laboratory, P. O. Box 808 L-156, Livermore, California 94550). *Journal of Mathematical Physics (New York);* **28**: No. 1, 244-245(Jan 1987). Contract W-7405-ENG-48.

A result of Debye, Anderson, and Brumberger [P. Debye, H. R. Anderson, Jr., and H. Brumberger, J. Appl. Phys. 28, 679 (1957)] for isotropic porous media states that the derivative of the two-point spatial correlation at the origin is equal to minus one-quarter of the specific surface area. This result is generalized for nonisotropic media by noting that the angular average of the anisotropic two-point spatial correlation function has the same relationship to the specific surface area.

24121 **Band theory of superlattices.** Elci, A. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review* [*Section*] *B: Condensed Matter;* **34**: No. 12, 8616-8628(15 Dec 1986).

We present a first-principles theory of the band structure of lattice-matched superlattices. We formulate the one-electron problem of superlattices in the Bloch representation of one of the constituent materials. In this formulation, the symmetry breaking along the superlattice axis leads to partitioning and folding of the original homogeneous crystal Brillouin zone onto a thin region around the center of the zone. A single homogeneous crystal Bloch function becomes a multicomponent wave function. Each component represents a superlattice subband. We use Loewdin's theorem to derive

series expressions for the subband energies and wave functions, and discuss the relation between these solutions and the eigenvalues and eigenfunctions corresponding to quantum-well models. We apply the general results to a superlattice composed of two different types of simple two-band model materials.

24122 **Trithallium(I) phosphate, an optical second-harmonic generator.** Zalkin, A.; Templeton, D.H.; Eimerl, D.; Velsko, S.P. (Lawrence Berkeley Lab., CA, USA. Materials and Molecular Research Div.; Lawrence Livermore National Lab., CA, USA). *Acta Crystallographica, Section C: Crystal Structure Communications;* **42**: No. 12, 1686-1687(15 Dec 1986).

Tl/sub 3/PO/sub 4/, M/sub r/=708.08, hexagonal, P6/sub 3/, a=8.369 (8), c=5.111 (5) A, V=310.0 A/sup 3/, Z=2, D/sub x/=7.59 g cm/sup -3/, MoKα, λ(α/sub 1/)=0.70930 A, μ=787.6 cm/sup -1/, F(000)=580, T=296 K, R=0.017 for 241 reflections. The thallium(I) ion is coordinated to oxygen from three different phosphate groups at distances 2.529 (7), 2.553 (5) and 2.555 (8) A. These distances are comparable to the shortest Tl-O distances reported for other compounds.

24123 **On the interpolation of eigenvalues and a resultant integration scheme.** Koelling, D.D.; Wood, J.H. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Computational Physics;* **67**: No. 2, 253-262(Dec 1986). Contract W-31-109-ENG-38.

The interpolation of one-electron energy band eigenvalues by way of an interpolating function expanded as a linear sum of star functions with expansion coefficients determined via a spline-like variational scheme is described. We discuss the practical aspects of such a scheme (first, set up by Shankland) and establish that it is a viable one; we then observe that it can serve as the basis of a very useful integration scheme. The viability is established through a discussion of the choice of the interpolating function and the associated problems of point set selection and truncation of the expansion. The proposed integration scheme arises from the crucial observations that the interpolation formalism can be described in terms of a transfer matrix which operates on the data to yield the expansion coefficients; this matrix depends on the choice of the variational, the point set, and the truncation but not the data. This allows one to produce a very powerful integration scheme which is applicable to a wide class of problems. copyright Academic Press, Inc.

24124 **Positron or positronium-like surface state on Al(100).** Lynn, K.G.; Mills, A.P. Jr.; West, R.N.; Berko, S.; Canter, K.F.; Roellig, L.O. (Brookhaven National Lab., Upton, NY). *Physical Review Letters;* **54**: No. 15, 1702-1705(15 Apr 1985). Contract AC02-76CH00016.

Using a high-intensity beam of 200-eV positrons the authors have measured the two-dimensional angular correlation of the 2γ annihilation radiation from a clean Al(100) surface. The momentum distribution identified with the positron surface state has a nearly isotropic conical shape and a (7.1 +/- 0.5)-mrad full width at half maximum. The data are not consistent with a simple interpretation based on either the usual model of a positron bound in a surface state by its image-correlation potential or a positronium atom weakly bound to the surface. 15 references, 3 figures.

24125 **Charged vortex excitations in quantum Hall systems.** Sokoloff, J.B. (Northeastern Univ., Boston, MA). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 4, 1924-1928(15 Feb 1985). Contract FG02-84ER45079.

Some consequences of the existence of charged vortex excitations in systems exhibiting the quantum Hall effect are discussed, as well as the conditions under which such excitations are expected to occur. 10 references.

24126 **Stochastic theory of scattering from idealized spinodal structures.** Hopper, R.W. (Lawrence Livermore National Lab., CA). *Journal of Non-Crystalline Solids;* **70**: 111-142(1985). Contract W-7405-ENG-48.

Certain model late stage spinodal structures can be generated mathematically by the relation ΔC/sub L/(r) = G[ΔC$_0$(r)], where ΔC/sub L/(r) is the composition deviation from the mean of the late stage structure and ΔC$_0$(r) is a random superposition of waves. Then the autocorrelation function (ACF) of ΔC/sub L/(r) depends only on the ACF of ΔC$_0$(r), and the latter is related simply to the distribution of wavelengths present. Coherent scattering can be computed from the ACF. The basic late stage model (BLSM) is defined by G(ΔC) = 2H(ΔC)-1, where H(x) is the Heaviside step function. This converts the smooth, wavy ΔC$_0$(r) into a late stage structure having the same morphology but equilibrium compositions an sharp interfaces. The scattering theory formalism is developed generally and then applied to the BLSM using illustrative wavelength distributions. Scattering as a function of angle and wavelength is computer. It is also found that the BLSM turbidity ~Ck^{4}w vector^3, where w vector is the mean phase width and C depends only weakly upon the wavelength distribution of ΔC$_0$(r). 48 references, 4 figures, 1 table.

24127 **Phase diagram of the ground state of spin-1 quantum chains.** Chui, S.T.; Ma, K.B. (Univ. of Delaware, Newark). *Physical Review* [*Section*] *B: Condensed Matter;* **29**: No. 3, 1287-1291(1 Feb 1984). Contract AC02-82ER12060.

A general phase diagram for anisotropic quantum spin chains is presented for the first time. The way in which the classical limit is approached is suggested. The nature of the instantons in these systems is discussed. 17 references, 3 figures.

24128 **Implications of heavy-ion-induced satellite x-ray emission I.** Raman, S.; Vane, C.R. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B3**: 71-77(1984). Contract W-7405-ENG-26.

Regardless of how they are induced, x-ray spectra are sensitive to the chemical environment of the emitting atom and can yield information on the atomic and electronic structure of host materials. Those spectra resulting from heavy-ion excitation are discussed in this series of papers. Highly energetic heavy ions are capable of producing multiple inner-shell ionization. The resulting spectrum of x-rays from a particular target atom is composed of a complex series of satellite lines. Environmental effects give rise to the redistribution of intensity from one satellite group to another. These changes can be correlated with bulk chemical properties (valence-electron densities, effective charges, covalencies, etc.). The possibility of obtaining new chemical information (e.g., in implanted materials and in metal alloys) exists but requires greater experimental and theoretical understanding of both parametric variations and the fine structure of satellite lines. 44 references, 5 figures, 1 table.

24129 **Implications of heavy-ion-induced satellite x-ray emission II.** O'Kelley, G.D.; Auble, R.L.; Hulett, L.D. Jr.; Kim, H.J.; Milner, W.T.; Raman, S.; Shahal, O.; Vane, C.R.; Young, J.P.; Lapicki, G. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B3**: 78-87(1984). Contract W-7405-ENG-26.

Cross sections are reported for x-ray production in targets of $_{23}$V, $_{29}$Cu, $_{41}$Nb, $_{73}$Ta, and $_{78}$Pt by ^{40}Ar ions of 36.0, 56.4, 76.6 and 103 MeV. Because the targets were relatively thick, ~ 1 mg/cm^2, the data were corrected - using a novel approach - for projectile energy loss and x-ray attenuation in the targets. The cross sections so analyzed are compared with the predictions of the first Born approximation as well as with those of a more extensive treatment which includes energy loss, Coulomb deflection, perturbed stationary-state, and relativistic effects. The significant discrepancies between the data and this latter theory are attributed primarily to the influence of multiple ionization on the x-ray emission probabilities. 19 references, 9 figures, 5 tables.

24130 **Implications of heavy-ion-induced satellite x-ray emission III.** Vane, C.R.; Hulett, L.D. Jr.; Kahane, S.; McDaniel, F.D.; Milner, W.T.; O'Kelley, G.D.; Raman, S.; Rosseel, T.M.; Slaughter, G.G.; Varghese, S.L.; Young, J.P. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B3**: 88-93(1984). Contract W-7405-ENG-26.

High-resolution (~ 7 eV at 2.3 keV) sulfur K/sub α/ x-ray spectra have been obtained for a series of sulfur compound targets under heavy-ion impact at the Holifield Heavy Ion Facility. The spectra observed are dominated by a series of satellite peaks arising from varying degrees of L-shell ionization at the time of x-ray emission. Each spectral profile has been parameterized by a single variable p/sub L/, the apparent average L-shell ionization probability. Correlations are evident between p/sub L/ and the corresponding sulfur atom chemical environment. Much stronger correlations are, however, found for variations of some individual peak intensities with specific chemical parameters. Comparison of results for Ar/sup q+/ and Kr/sup q+/ projectiles show that while L-shell ionization probability has increased, chemical sensitivity has apparently saturated. 7 references, 5 figures, 2 tables.

24131 **Implications of heavy-ion-induced satellite x-ray emission IV.** Rosseel, T.M.; Dale, J.M.; Dunn, H.W.; Hulett, L.D. Jr.; Kahane, S.; Krause, H.F.; Raman, S.; Slaughter, G.G.; Vane, C.R.; Young, J.P. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B3**: 94-99(1984). Contract W-7405-ENG-26.

The L x-ray satellites produced by 1 MeV/u Cl/sup q+/ bombardment of a series of molybdenum compounds and alloys were examined using a high-resolution (7 eV at 2.3 keV) crystal spectrometer. The normalized emission spectra exhibited variations in the intensity distribution of the L/sub α//sup n/M/sup m/ and L/sub β//sup n/M/sup m/ satellites for different targets. Using Mo metal as a reference or subtrahend, amplification of the intensity variations was obtained by calculating difference spectra. Select regions of these difference spectra displayed systematic variations that were correlated to the valence-electron density of the material. These results clearly demonstrate that heavy-ion-induced L x-ray satellites may be used to probe the chemical environment of intermediate Z elements. In addition, the alloy results may provide a basis for the application of this technique to a variety of materials problems. 14 references, 4 figures, 2 tables.

24132 **Implications of heavy-ion-induced satellite x-ray emission V.** Raman, S.; Kaellne, E.; Kaellne, J.; Nakajima, T.; Nestor, C.W. Jr.; Stelson, P.H.; Vane, C.R.; Walkiewicz, T.A. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B3**: 100-103(1984). Contract AC02-76ET53052;W-7405-ENG-26.

The authors have studied K/sub α/ x-ray emission induced by 34 MeV ^{35}Cl ions from several compounds at the ORNL EN Tandem Van de Graaff with a high-throughput, high-resolution Bragg crystal spectrometer in the Van Hamos geometry. The x-rays are diffracted off a cylindrically curved, highly reflective quartz crystal and detected with a position-sensitive proportional counter. The resolution of the spectrometer was better than one part in 2000. The data show remarkable and distinct fine structure in the individual KL/sup n/ satellite peaks. Such data should aid in eventual comparisons with structures predicted by theoretical transition energy and intensity calculations. 8 references, 3 figures.

24133 **Ion beam analysis of irradiated materials.** Averback, R.S. (Argonne National Lab., IL). *Materials Science Forum;* **2**: 99-122(1984).

Ion beam analysis is a simple yet powerful method to analyze the composition and structure of the surface region of a material. In this review, the basic principles of Rutherford backscattering and ion channeling are described, and various applications of ion beam analysis of irradiated materials are illustrated. Examples involving ion-beam mixing and radiation-induced segregation demonstrate that by using Rutherford backscattering, changes in the composition of a material over distances greater than 25 A are readily detected. The use of ion channeling to determine the site location of solute or impurity atoms is also described. The specific problem of determining the configuration of a complex which is formed by a self-interstitial and solute atom is discussed. 26 references, 13 figures.

24134 **Computer simulations of multiple-quantum NMR experiments. I. Nonselective excitation.** Murdoch, J.B.; Warren, W.S.; Weitekamp, D.P.; Pines, A. (Lawrence Berkeley Lab., CA). *Journal of Magnetic Resonance;* **60**: 205-235(1984). Contract AC03-76SF00098.

The multiple-quantum (MQ) evolution of anisotropic spin systems with four to eight coupled protons is analyzed using a computer for the basic three-pulse sequence. MQ intensities are first investigated as a function of preparation time. The concept of time-independent intensities is then introduced, and an algorithm for efficient computation of these quantities is described. A correlation between the distribution of dipolar coupling values and the intensity of high-quantum lines is discussed; in many cases, these intensities are predicted to be considerably larger than a simple statistical argument would suggest. The effect of varying the preparation and detection times independently is analyzed as a random walk problem. 45 references, 14 figures, 5 tables.

24135 **Calculation of coherent phase equilibria.** Williams, R.O. (Oak Ridge National Lab., TN). *CALPHAD: Computer Coupling of Phase Diagrams and Thermochemistry;* **8**: No. 1, 1-14(1984). Contract W-7405-ENG-26.

The authors have derived expressions for the elastic energy for coherent mixtures for two important morphologies. The compositions of the two phases comprising the coherent mixture are found by minimizing the total energy. The composition difference may be smaller or larger than the equilibrium difference. Each of the phases can be restricted to some maximum volume fraction such that the composition range over which a coherent mixture can exist is necessarily less than for the equilibrium mixture. The elastic energy can be so large that a coherent mixture cannot form. 30 references, 12 figures, 1 table.

24136 **Diffusion correlation and isotope effects in high-defect-content solids.** Murch, G.E. (Argonne National Lab., IL). *Philosophical Magazine, [Part] A: Defects and Mechanical Properties;* **49**: No. 1, 21-29(1984). Contract W-31-109-ENG-38.

The tracer correlation factor for diffusion via non-interacting vacancies has been calculated by a Monte Carlo method for the simple-cubic lattice with a variable vacancy content. Particular emphasis has been placed on obtaining results of very high precision. The results are in excellent agreement with the recent analyses by Nakazato and Kitahara, and Tahir-Kheli and Elliott. In a separate calculation the tracer correlation factor in the same model has been calculated using a Monte Carlo method analogous to the experimental method used for measuring diffusion isotope effects. Good agreement was obtained with the direct method, indicating that in this model the tracer correlation factor can be well represented by the impurity correlation factor form. 19 references, 2 figures, 1 table.

24137 **Effect of interplane coupling in quasi-two-dimensional systems.** Chui, S.T. (Univ. of Delaware, Newark). *Physical Review [Section] B: Condensed Matter;* **28**: No. 5, 2863-2865(1 Sep 1983). Contract AC02-82ER12060.

There are many divergent susceptibilities in two-dimensional systems that are not associated with phase transitions. The authors propose that when stacks of planes of these two-dimensional systems are coupled together, these divergences indicate genuine phase transitions. Applications to melting, commensurate-incommensurate transitions, and superconductivity are pointed out. 14 references, 1 figure, 1 table.

24138 **Auger lineshape analysis.** Madden, H.H. (Sandia National Lab., Albuquerque, NM). *Surface Science;* **126**: 80-100(1983). Contract AC04-76DP00789.

Auger transitions occurring at solid surfaces give spectra containing information on the energy distribution of valence electrons involved in the transition. Thus Auger Electron Spectroscopy (AES) can be used as a valence band (VB) spectroscopy that is surface sensitive. Analyses of a number of core-valence-valence (CVV) Auger spectra are reviewed to illustrate the VB information contained in their lineshapes and to indicate current understanding of the physics of the Auger process as it applies to solids. The

KVV spectrum from elemental beryllium is an example of a CVV line that can be analyzed simply in terms of the sum of convolution products of independent-particle VB density-of-states (DOS) components. Other elemental solids for which such simple arguments suffice include Al, Si, Li, Ti, Co and B. The CVV spectra from copper are discussed as examples of CVV lineshapes that are distorted from those expected from simple VB DOS arguments because localization in the two-hole Auger final state for Cu makes hole-hole interactions important in determining the Auger lineshapes. Initial state screening is shown to influence the CVV lineshapes from Be as well as Cu. CVV spectra from the compound surfaces BeO and SiO_2 are analyzed using concepts of interatomic transitions as well as independent-particle VB arguments. These spectra show that AES is a probe of the local DOS about the core-hole site. This ability of AES to give local bonding information is illustrated by analyses of CVV spectra from multi-component surface which may be made in terms of the simple superposition of local-bonding signals. Thus the $SiL_{23}VV$ signal from silicon oxynitride is shown to be the superposition of signals representing elemental Si, Si-H, Si-N and Si-O bonding. 72 references, 9 figures.

6561 Superconductivity

REFER ALSO TO CITATION(S) 22823, 22855, 22876

24139 **(DOE/ER/45113—3) Magnetic impurities in superconductors: Performance report, July 1, 1986-August 31, 1987.** Ruvalds, J. (Virginia Univ., Charlottesville (USA). Dept. of Physics). 1987. Contract FG05-84ER45113. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006338.

The primary objectives of this report have involved various phenomena in superconductors, with a goal toward formulating a procedure for finding new materials that function at desirable temperatures and exhibit high critical magnetic fields. Much of the effort was devoted to the investigation of the interaction of rare earth impurity spins in a system of conduction electrons which may become superconducting. The normal state resistivity of various heavy fermion alloys has been examined in order to determine the fundamental interactions responsible for the competition between magnetic ordering and superconductivity. Also, the initial research effort on possible room temperature superconductivity of metallic hydrogen has been described. Other topics covered in this report have been the investigation of charge and spin-density waves and the study of electron relaxation relations and transient spectroscopy of α-Si:H. (FI)

24140 **(IC—86/120) Ac losses in a type-II superconducting slab including surface barrier effects.** Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701410.

The structure of a surface barrier, in the frame of the general critical-state theory, of a type II superconducting slab subjected to parallel magnetic fields (in which the direction of the dc bias and ac field are left arbitrary) has been incorporated in this paper. The internal magnetic field distribution has been developed. In the case of the amplitude of ac field (b/sub O/) less than the magnitude of the dc bias field (B/sub O/), analytic expressions for ac losses are obtained. Maximum values of FL cutting and flux-pinning losses are also determined. A good agreement with the previous results (in this case of α/sub O/=O with absence of surface barrier effects) is obtained. 20 refs, 1 fig, 2 tabs.

24141 **(IC—86/199) Brillouin-Wigner theory of mixed-valence impurities in BCS superconductor: T/sub c//T/sub cO/ and ΔC/ΔC/sub O/.** Li Jun; Gong Changde. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701538.

The (lowest order) Brillouin-Wigner perturbational expansion theory is adopted to describe the mixed-valence impurities in the BCS superconductor. Two substantial quantities characterizing the superconducting state, i.e. the reduced transition temperature T/sub c//T/sub cO/ and the reduced specific heat jump ΔC/ΔC/sub O/ are calculated numerically as a function of the impurity concentration x and the energy level difference E/sub f/ between two 4f configurations. A comparison with the experimental data of the Th/sub 1-x/Ce/sub x/ and Th/sub 1-x/U/sub x/ alloy is also included with a more reasonable fitting than Kaiser's theory. 8 refs, 3 figs.

24142 **(LA-UR—87-389) Experimental summary.** Smith, J.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870142—7). NTIS MF A01; 2; GPO Dep. File Number DE87006053.

From 5. international conference on valence fluctuations; Bangalore, India (5 Jan 1987).

This brief paper discusses various items covered in this conference: local moment magnetism, heavy fermions, d-electron transition metals, superconductivity, heavy electrons, ordered compounds and impurities, etc. There is a continuum in the physics, ranging from local f-electron moments through heavy fermions through mixed valence to conventional energy band metals with trivial Fermi surfaces. (DLC)

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 23768, 23818, 23927, 24120

24143 **(CONF-870459—) Workshop report on new directions in x-ray scattering.** Brown, G.; Del Grande, N.K.; Fuoss, P.; Mallett, J.H.; Pratt, R.; Templeton, D. (Stanford Univ., CA (USA); Lawrence Livermore National Lab., CA (USA); Bell Labs., Holmdel, NJ (USA); Pittsburgh Univ., PA (USA); Lawrence Berkeley Lab., CA (USA)). 1 Feb 1987. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006305.

From Workshop report on new directions in X-ray scattering; Pacific Grove, CA, USA (2 Apr 1987).

This report is a summary of the Workshop on New Directions in X-Ray Scattering held at the Asilomar Conference Center, Pacific Grove, California, April 2-5, 1985. The report primarily consists of the edited transcript of the final review session of the workshop, in which members of a panel summarized the proceedings. It is clear that we are close to achieving an accurate theory of scattering in independent particle approximation, but for edge regions, there is need to go beyond this approach. Much of what is experimentally interesting in scattering is occurring between the photoabsorption edge and the photoelectric threshold. Applications in condensed matter and biological and chemical material studies are expanding, exploiting higher intensity sources and faster time resolution as in magnetic scattering and surface studies. Storage rings are now conventional sources, and new high-intensity beam lines are under development; the free electron laser is one of the more speculative sources. Recent work in x-ray scattering has led to advances in x-ray optics, and conversely, advances in x-ray optics have benefitted our understanding of x-ray scattering.

24144 (EUR—9708-Vol.2, pp 817-836) **Chaos, strange attractors and nonlinear dynamics.** Ott, E. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Concepts of nonlinear dynamics in chaotic dissipative systems are reviewed and recent developments pointed out. Topics covered include strange attractors, how chaos comes about with variation of a system parameter, universality, chaotic repellers and their effect on predictability, and plasma applications.

24145 **(GSI—86-44-Prepr.) Angular momentum projected semiclassics.** Hasse, R.W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751223.

By using angular momentum projected plane waves as wave functions, we derive semiclassical expressions for the single-particle propagator, the partition function, the nonlocal density matrix, the single-particle density and the one particle- one hole level density for fixed angular momentum and fixed z-component or summed over the z-components. Other quantities can be deduced from the propagator. In coordinate space (r, r') the relevant quantities depend on vertical stroker - r/sup 3/vertical stroke instead of vertical stroker - r'vertical stroke and in Wigner space (R, P) they become proportional to the angular momentum constraints δ(vertical strokeRxPvertical stroke/Planck constant - l) and δ((RxP) /sub z//Planck constant - m). As applications we calculate the single-particle and one particle- one hole level densities for harmonic oscillator and Hill-Wheeler box potentials and the imaginary part of the optical potential and its volume integral with an underlying harmonic oscillator potential and a zero range two-body interaction.

24146 **(IC—86/155) K-Kolmogorov homology groups.** Abd El-Sattar, A.D. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701523.

In the present work we use the idea of the K-groups to define the K-Kolmogorov homology groups, and their induced homomorphisms and boundary operators for the case of a pair of discrete coefficient groups, where K denotes a locally-finite simplicial complex. Moreover, we prove that our homology construction is exact. 12 refs.

24147 **(IC—86/164) Bivariational calculations for radiation transfer in an inhomogeneous participating media.** El Wakil, S.A.; Machali, H.M.; Haggag, M.H.; Attia, M.T. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701526.

Equations for radiation transfer are obtained for dispersive media with space dependent albedo. Bivariational bound principle is used to calculate the reflection and transmission coefficients for such media. Numerical results are given and compared. 8 refs, 1 tab.

24148 **(IC—86/180) Attractor in a superstring model. The Einstein theory, the Friedmann universe and inflation.** Maeda, K. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701529.

In a superstring model, the minimum of the SUSY breaking potential through a gluino condensation provides a no-scale model, which may explain the hierarchy problem, permit inflation and give zero cosmological constant naturally. It is shown that the above minimum is an attractor in the dynamical system. This minimum also guarantees the 4-dimensional Einstein gravity theory, rather than the Brans-Dicke theory, in the low energy limit. Using this model, a preferential scenario of evolution towards (the 4-dimensional Friedmann universe) x (a constant Calabi-Yau space) via inflation is discussed. A series of phase transitions due to a quantum tunnelling of the quantized antisymmetric field H/sub μνrho/ may occur, forming a hierarchical bubble structure. 35 refs, 6 figs.

24149 **(IC—86/182) Generalized quantal equation of motion.** Morsy, M.W.; Embaby, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701531.

In the present paper, an attempt is made for establishing a generalized equation of motion for quantal objects, in which intrinsic self adjointness is naturally built in, independently of any prescribed representation. This is accomplished by adopting Hamilton's principle of least action, after incorporating, properly, the quantal features and employing the generalized calculus of variations, without being restricted to fixed end points representation. It turns out that our proposed equation of motion is an intrinsically self-adjoint Euler-Lagrange's differential equation that ensures extremization of the quantal action as required by Hamilton's principle. Time dependence is introduced and the corresponding equation of motion is derived, in which intrinsic self adjointness is also achieved. Reducibility of the proposed equation of motion to the conventional Schroedinger equation is examined. The corresponding continuity equation is established, and both of the probability density and the probability current density are identified. 11 refs.

24150 **(IC—86/195) Novel resonant processes in one-dimensional elastic scattering.** Garcia-Calderon, G. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701535.

The effect of ordered and disordered arrays on resonant elastic scattering is considered by using some simple properties of the propagator. A crucial role is played by the residues at the complex poles which define the resonant eigenstates. The main effect of disorder near resonance energy is to modify the coupling of the resonant eigenstate with the end points of the system. This may lead to situations where decay occurs through the incident direction resulting in the almost disappearance of the transmission peak. The results throw light on the formation process of localized and extended states in single systems. 10 refs.

24151 **(IC—86/196) Expansion of continuum wave functions in terms of resonant states. 2. Solvable models.** Garcia Calderon, G.; Rubio, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701536.

This paper applies a formalism which provides a purely discrete expansion for a continuum wave solution of the Schroedinger equation in terms of resonant states along the interior region of a finite range interaction. We consider two exactly solvable models for several values of the distance and momenta on and off resonance. Our results are compared with a recent approach by Bang and collaborators which involves subtraction terms. It is found that along the internal region the subtraction terms are not in general negligible. Our work substantiates an expression for the continuum wave function near resonance. We also obtain an equation for time delay in terms of resonant states. 28 refs, 7 tabs.

24152 **(IC—86/201) N-level atom and (N-1) modes: Detuning, dynamics and statistical aspects.** Abdel-Hafez, A.M.; Obada, A.S.F. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701540.

A model is presented to investigate the problem of interaction between an N-level atom and (N-1) modes of the field. The model includes the effect of detuning. Constants of motion are obtained. The evolution operator is calculated. The probability distribution function for the photons numbers is computed for different initial atomic states. The characteristic functions are computed. Different statistical quantities concerning the photons or the atomic system are given. It is found that if the atom starts from a definite state then the photon number never exceeds its initial value in the mode that effects the interaction between this state and the uppermost state. On the other hand, in the other modes the photon numbers at any time are never less than the initial value. 7 refs, 1 fig.

24153 **(IC—86/202) Three-level atom and two modes: Generalized models and multiphotons.** Abdel Hafez, A.M.; Obada, A.S.F.; Ahmad, M.M.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701541.

A generalized model is presented for the interaction between a 3-level atom and a 2-mode field. The interaction depends on functions on the photon numbers in the modes. There is also detuning included. The use of spin-1 operators to describe the atomic system is emphasized. Different statistical quantities are computed for the photons and the atomic system in the general case. Multiphoton processes, whether cascade or scattering, are discussed by using specific formulae for the photon numbers functions. A model is presented in which infinite sums tend to elementary functions or infinite integrals in the two cases of thermal and coherent distributions for the two modes. 14 refs.

24154 **(IC—86/204) K-Kolmogorov cohomology groups.** Abd El-Sattar, A.D. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701543.

In the present work we use the idea of K-groups to give a description of certain modification of the Kolmogorov cohomology groups for the case of a pair (G,G') of discrete coefficient groups. Their induced homomorphisms and coboundary operators are also defined, and then we study the resulting construction from the point of view of Eilenberg-Steenrod axioms. 17 refs.

24155 **(IC—86/214) Radiation transfer in sphere with internal source.** Saad, E.A.; El Wakil, S.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701545.

In this note, we connect the problem of radiation transfer in a sphere with diffuse reflectivity and containing an energy source with the problem of source free radiation transfer with isotropic boundary condition. Equation for the radiative heat flux is obtained for a polynomial source. In the special case of uniform source, the radiation heat flux and the angular flux are given in terms of the albedo of the second problem. 5 refs.

24156 **(IC—86/221) Some remarks on a result of Toppila.** Liverpool, L.S.O. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701546.

This investigation shows how to generalize a condition of Toppila for Picard sets of entire functions. His result is a particular case of our new theorem. 9 refs.

24157 **(IC—86/237) Generalized Jaynes-Cummings model for the N-level atom and (N-1) modes.** Abdel-Hafez, A.M.; Abu-Sitta, A.M.M.; Obada, A.S.F. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701551.

A generalized Jaynes-Cummings model is presented to discuss the interaction between an N-level atom and N-1 modes of the radiation field. The level to which the rest of the levels are connected lies in the middle. A detuning parameter is introduced. Distribution functions and characteristic functions are calculated. Different statistical averages are obtained. 16 refs.

24158 **(IC—86/238) Oscillatory behaviour of solutions of first-order ordinary and delay differential equations.** Parhi, N. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701552.

In this work, sufficient conditions have been obtained for oscillation-non-oscillation of solutions of non-linear non-homogeneous first-order ordinary and delay differential equations. 10 refs.

24159 **(IC—86/250) Note on generalized metrics on complex manifolds.** Rastogi, S.C. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701554.

In 1981, Hojo introduced a generalized metric function PHI/sup (P)/, p(not =1) is a real number in a Finsler space and studied some beautiful consequences of such a metric function. The aim of this paper is to investigate the possibility of introducing a similar metric function on a complex manifold studied by Rund. It is interesting to note that such an introduction is unnatural for values of p other than 2, which corresponds to the metric function introduced by Rund. 3 refs.

24160 **(IC—86/254) Some curvature properties of quarter symmetric metric connections.** Rastogi, S.C. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701555.

A linear connection Γ/sub ji//sup h/ with torsion tensor T/sub j//sup h/P/sub i/-T/sub i//sup h/P/sub j/, where T/sub j//sup h/ is an arbitrary (1,1) tensor field and P/sub i/ is a 1-form, has been called a quarter-symmetric connection by Golab. Some properties of such connections have been studied by Rastogi, Mishra and Pandey, and Yano and Imai. In this paper based on the curvature tensor of quarter-symmetric metric connection we define a tensor analogous to conformal curvature tensor and study some properties of such a tensor. 6 refs.

24161 **(IC—86/272) Generalization of the Hellmann-Feynman theorem to Gamow states.** Ziesche, P.; Kunze, K.; Milek, B. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701558.

The Hellmann-Feynman theorem valid for the parameter dependence of bound states is generalized to the case of Gamow states using an appropriate definition of scalar products and expectation values with such states. The one-dimensional square well potential is considered as an illustrating example. 21 refs.

24162 **(IC—86/295) Relativistic atomic structure studies via density functional theory.** Das, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701560.

Relativistic many-body treatment is essential for the study of structures and spectra of heavy atomic systems. In this talk we shall present our attempts to understand the atomic structure of heavy elements and super-heavy elements via a relativistic density functional theory. The relativity is taken care of by the kinematic description of Dirac electrons whereas the many-body aspect is incorporated through exchange-correlation processes. As practical applications the results of our calculations for the inner-shell structures of several heavy atoms will be presented. 18 refs.

24163 **(IC—86/329) Perturbative and global anomalies in supergravity theories.** Sezgin, E. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701562.

Perturbative and global anomalies in supergravity theories are reviewed. The existence of a matter and gauge coupled supergravity theory in six dimensions with E/sub 6/xE/sub 7/xU(1) symmetry and highly nontrivial anomaly cancellations is emphasised. The possible string origin of this theory is posed as an open problem, study of which may lead to discovery of new ways to construct/compactify heterotic superstrings. 35 refs.

24164 **(INIS-mf—10348) Toeplitz operators - an asymptotic quantization of symplectic cones.** Boutet de Monvel, L. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)). 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751328.

BiBoS.; No. 215/86.

Let Σ be a symplectic manifold, H a Hilbert space. It is not possible to represent the group of symplectic automorphisms of Σ in the group of unitary operators of H in a manner nicely linked with the geometry of Σ. However if Σ is the cotangent bundle of a manifold X, unitary Fourier integral operators acting on L/sup 2/(X) provide an asymptotic analogue: they move the wave front set of distributions according to some homogeneous symplectic map. We describe here a similar construction for any symplectic cone with a compact basis. A good model for this is given by the algebra of Toeplitz oeprators on a complex domain. (orig./HSI).

24165 **(INIS-mf—10349) Feynman path integrals and the classical limit.** Rezende, J. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751327.

BiBoS.; No. 132/85.

The author discusses the properties of the Feynman path integral required for its use in semiclassical treatment of the Schroedinger equation. (HSI).

24166 **(INIS-mf—10350) Stochastic diffusions for the Fermi oscillator.** Garbaczewski, P. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751326.

BiBoS.; No. 232/86.

Solutions of the Schroedinger equation for the two-level system induce well defined controlled stochastic Markov processes, which form a subset of those characterizing the quantum oscillator problem.

24167 **(INIS-mf—10351) About the unitary discretizations of Heisenberg equations of motion.** Vazquez, L. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751325.

BiBoS.; No. 233/86.

In a recent paper Bender et al. (1985) have used a unitary discretization of Heisenberg equations for a one-dimensional quantum system in order to obtain information about the spectrum of the underlying continuum theory. The method consists in comparing the matrix elements between adjacent Fock states of the operators and at two steps. At the same time a very simple variational approach must be made. The purpose of this paper is to show that with unitary schemes, accurate either to order tau or tau/sup 2/, we obtain the same spectrum results in the framework of the above method. On the other hand the same eigenvalues are obtained with a non-unitary scheme (Section II). In Section III we discuss the construction of the Hamiltonian associated to the unitary discretizations.

24168 (INIS-mf—10589, pp 10-11) **Supertwistors.** Kotrla, M. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24169 (INIS-mf—10589, pp 16-17) **Representations of Lie superalgebra osp(1,2n), n=1,2.** Blank, J.; Havlicek, M. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24170 (INIS-mf—10589, pp 18-19) **Realizations of simple Lie algebras.** Burdik, C. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24171 (INIS-mf—10589, pp 30-31) **Position operators in relativistic quantum mechanics.** Pazma, V. (Komenskeho Univ., Bratislava, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24172 (INIS-mf—10589, pp 52-53) **Thermal neutron diffraction and quantum mechanics.** Kulda, J.; Lukas, P.; Mikula, P. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24173 (INIS-mf—10589, pp 83-84) **Point interactions in nuclear physics.** Seba, P. (Karlova Univ., Prague, Czechoslovakia). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24174 (INIS-mf—10589, pp 8-9) **Non-linear realization of minimal Einstein N=1 supergravity.** Ivanov, E.A.; Niederle, J. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). 1985. (In Czech). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24175 (INIS-mf—10589, pp 48-49) **Transformation properties of Euler angles of a relativistic spinning top.** Fecko, M. (Komenskeho Univ., Bratislava, Czechoslovakia). 1985. (In Slovak). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701626. (CONF-8508223—Pt.1-Vol.1).

From 8. conference of Czechoslovak physicists; Bratislava, Czechoslovakia (26 Aug 1985).

24176 **(JINR—E-17-85-967) On the stability of solitary waves of the (phi/sup 3/ - phi/sup 5/)-nonlinear Schroedinger equation under non-vanishing boundary conditions.** Barashenkov, I.V.; Gocheva, A.D.; Makhankov, V.G.; Puzynin, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701589.

The stability of the bubble-like soliton solution of the equation is examined: ipsi/sub t/+psi/sub xx/+αpsi+psichemical bondpsichemical bond/sup 2/-psichemical bondpsichemical bond/sup 4/=0, where psi(x, t) -> psi /sup +-/=const as x -> +- infinity. The analysis of the above equation linearized about the static bubble is reduced to an eigenvalue problem for two coupled Schroedinger operators. This problem is found to possess a bound state solution for all a. Cosequently, there exist exponentially growing perturbations, and motionless bubble appears to be always unstable. The dependence of the growth rate on a is numerically calculated. 14 refs.

24177 **(LA-UR—87-258) Propagation of near-infrasound over long ranges.** Mutschlecner, J.P.; Whitaker, R.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 39p. (CONF-8610228—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005095.

From Atmospheric and meteorological effects on low-frequency, long-range sound propagation; Albuquerque, NM, USA (27 Oct 1986).

This paper describes the results of basic research on the physics of infrasonic propagation, both for predictive purposes and signal interpretation. The following aspects were considered: (1) attenuation, (2) seasonal effects, (3) wave effects, (4) average velocity, (5) azimuth deviations, (6) coherence, and (7) surface effects. The primary region of interest was approximately 0.1 to Hz with corresponding wavelengths of 3000 to 30 meters. (ACR)

24178 **(NORDITA—85/9-Prepr.) On the quantum mechanical theory of stress and force.** Nielsen, O.H.; Martin, R.M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1985. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751247.

The stress theorem presented previously by the present authors is derived in detail and is related to the virial and force theorems. Stress fields are considered in two alternative forms, which both give the same macroscopic stress and forces on nuclei when integrated over appropriate surfaces. A crucial concept is interactions that "cross" surfaces. Explicit forms of the stress field within the local-density approximation are given, together with a generalization of the approximate Liberman form for pressure. Reciprocal-

space expressions and ab-initio calculations are considered in detail in an accompanying paper.

24179 **(NORDITA—85/22-Prepr.) Pregeometric quantum lattice: A general discussion.** Lehto, M.; Nielsen, H.B.; Ninomiya, M. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). May 1985. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751242.

We put forward an idea that the fundamental, i.e. pregeometric, structure of spacetime is given by an abstract set, so called abstract simplicial complex ASC. Thus, at the pregeometric level there is no (smooth) spacetime manifold. However, we argue that the structure described by an abstract simplicial complex is dynamical. This dynamics is then assumed to ensure that ASC can be realized as a lattice on a four-dimensional manifold with the simplest topologies dominating.

24180 **(OEFZS-A—0899) Use of the Boltzmann-equation for calculating the scattering law in gases.** Eder, O.J.; Lackner, T.; Posch, M. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1986. 8p. (PH—432/86). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

Limited distribution.

The incoherent scattering function in one dimension in a dilute gas mixture is derived from a model Boltzmann equation. For three dimensions the solution is given by an infinite continued fraction of infinite matrices of a special structure which allows an efficient numerical calculation of S/sub s/(q,w) and S(q,w). (G.Q.).

24181 **(UWThPh—1986-42) From free energy to entropy.** Narnhofer, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701608.

Several definitions for the entropy of subsystems are discussed. With the help of the corresponding free energy, it is argued that they give the same entropy density.

24182 **(UWThPh—1986-43) Free energy and the Kolmogorov-Sinai entropy of space translation.** Narnhofer, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701609.

The Kolmogorov-Sinai entropy is used in the variational principle of thermodynamics. It is shown that for lattice systems and short range interactions the corresponding equilibrium states are again the KMS-states and therefore KS-entropy of space translations and entropy density are the same. Finally some consequences for the third law of thermodynamics are discussed.

24183 **Quantum dynamics in a time-dependent variational approximation.** Cooper, F.; Pi, S.; Stancioff, P.N. (Department of Physics, Boston University, 590 Commonwealth Avenue, Boston, Massachusetts 02215). *Physical Review [Section] D: Particles and Fields;* **34**: No. 12, 3831-3841(15 Dec 1986).

The time-dependent variational method, which in many-body theory leads to the Hartree-Fock approximation, is here tested in quantum-mechanical models inspired by the physics of the inflationary universe. Some remarks about field-theoretic applications are also made.

24184 **Characterization of fat fractals in nonlinear dynamical systems.** Eykholt, R.; Umberger, D.K. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **57**: No. 19, 2333-2336(10 Nov 1986).

Fat fractals (sets with fractal structure, but nonzero measure) are becoming increasingly important in the study of nonlinear dynamical systems. Since fat fractals are not well characterized by their (integer) dimensions, several scaling exponents have been proposed to characterize these sets, and there has been some debate over which exponent is best. We shed light on this issue by examining these exponents and finding relationships between them. Finally, these results lead naturally to quantitative definitions of the notions of sensitivity to parameters and final-state sensitivity.

24185 **Monotone piecewise bicubic interpolation.** Carlson, R.E.; Fritsch, F.N. (Lawrence Livermore National Lab., CA). *SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis;* **22**: No. 2, 386-400(Apr 1985). Contract W-7405-ENG-48.

In a 1980 paper the authors developed a univariate piecewise cubic interpolation algorithm which produces a monotone interpolant to monotone data. This paper is an extension of those results to monotone script C^1 piecewise bicubic interpolation to data on a rectangular mesh. Such an interpolant is determined by the first partial derivatives and first mixed partial (twist) at the mesh points. Necessary and sufficient conditions on these derivatives are derived such that the resulting bicubic polynomial is monotone on a single rectangular element. These conditions are then simplified to a set of sufficient conditions for monotonicity. The latter are translated to a system of linear inequalities, which form the basis for a monotone piecewise bicubic interpolation algorithm. 4 references, 6 figures, 2 tables.

24186 **n-Series problems and the coupling of electromagnetic waves to apertures: a Riemann-Hilbert approach.** Ziolkowski, R.W. (Lawrence Livermore National Lab., CA). *SIAM Journal on Applied Mathemadics;* **16**: No. 2, 358-378(Mar 1985). Contract W-7405-ENG-48.

An effective approach to the solution of a large class of mixed boundary value problems (those reducible to an n-series problem) is developed. The method is based on the deduction of the equivalent Riemann-Hilbert problem and its solution. This generalized n-series approach leads to analytical descriptions of the coupling of electromagnetic waves through apertures in canonical structures into open or enclosed regions. In particular, it is applied to the canonical problem of plane wave coupling to an infinite circular cylinder with multiple infinite axial slots. Numerical results for currents induced by an H-polarized plane wave on a circular cylinder with a single slit are given. 9 references, 3 figures.

24187 **Block preconditioning for the conjugate gradient method.** Concus, P.; Golub, G.H.; Meurant, G. (Univ. of California, Berkeley). *SIAM Journal on Scientific and Statistical Computing;* **6**: No. 1, 220-252(Jan 1985). Contract AC03-76SF00098;AC03-76SF00515.

Block preconditioning for the conjugate gradient method are investigated for solving positive definite block tridiagonal systems of linear equations arising from discretization of boundary value problems for elliptic partial differential equations. The preconditioning rest on the use of sparse approximate matrix inverses to generate incomplete block Cholesky factorizations. Carrying out of the factorizations can be guaranteed under suitable conditions. Numerical experiments on test problems for two dimensions indicate that a particularly attractive preconditioning, which uses special properties of tridiagonal matrix inverses, can be computationally more efficient for the same computer storage than other preconditionings, including the popular point incomplete Cholesky factorization. 22 references, 6 figures, 12 tables.

24188 **Necessary and sufficient conditions for the existence of a conjugate gradient method.** Faber, V.; Manteuffel, T. (Los Alamos National Lab., NM). *SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis;* **21**: No. 2, 352-362(Apr 1984).

The authors characterize the class CG(s) of matrices A for which the linear system $Ax = b$ can be solved by an s-term conjugate gradient method. The authors show that, except for a few anomalies, the class CG(s) consists of matrices A for which conjugate gradient methods are already known. These matrices are the Hermitian matrices, $A^* = A$, and the matrices of the form A = e/sup i theta/(dI + B), with $B^* = -B$. 7 references.

24189 **Construction of one unstable manifold for the dissipative Henon mapping.** Valkering, T. (Twente Univ. of Technology, Enschede, Netherlands). *Journal of Physics A: Mathematical and General;* **17**: 3135-3142(1984). Contract AC03-77ER01538.

The unstable manifold of a saddle point of the Henon mapping is constructed analytically via a contraction mapping, for a

range of parameter values where the second fixed point is a stable node. One invariant piece of this manifold connects the saddle with the second fixed point. Rigorous error bounds are derived for each step of the iterative procedure. It is demonstrated that an algebraic approximation with known accuracy can be given of the unstable manifold. 11 references, 3 figures.

24190 **Linearization of second-order nonlinear oscillation theorems.** Kwong, M.K.; Wong, J.S.W. (Argonne National Lab., IL). *Transactions of the American Mathematical Society;* 279: No. 2, 705-722(Oct 1983). Contract W-31-109-ENG-38.

The problem of oscillation of super- and sublinear Emden-Fowler equations is studied. Established are a number of oscillation theorems involving comparison with related linear equations. Recent results on linear oscillation can thus be used to obtain interesting oscillation criteria for nonlinear equations. 25 references.

70 FUSION ENERGY

24191 **(DOE/OR/00033—T255) Magnetic Fusion Energy Technology Fellowship Program: Summary of program activities for calendar year 1985.** (Oak Ridge Associated Universities, Inc., TN (USA)). 1985. Contract AC05-76OR00033. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87004882.

This report summarizes the activities of the US Department of Energy (DOE) Magnetic Fusion Energy Technology Fellowship program (MFETF) for the 1985 calendar year. The MFETF program has continued to support the mission of the Office of Fusion Energy (OFE) and its Division of Development and Technology (DDT) by ensuring the availability of appropriately trained engineering manpower needed to implement the OFE/DDT magnetic fusion energy agenda. This program provides training and research opportunities to highly qualified students at DOE-designated academic, private sector, and government magnetic fusion energy institutions. The objectives of the Magnetic Fusion Energy Technology Fellowship program are: (1) to provide support for graduate study, training, and research in magnetic fusion energy technology; (2) to ensure an adequate supply of appropriately trained manpower to implement the nation's magnetic fusion energy agenda; (3) to raise the visibility of careers in magnetic fusion energy technology and to encourage students to pursue such careers; and (4) to make national magnetic fusion energy facilities available for manpower training.

24192 **(DOE/OR/00033—T275) Magnetic Fusion Science Fellowship program: Summary of program activities for calendar year 1986.** (Oak Ridge Associated Universities, Inc., TN (USA)). 1986. Contract AC05-76OR00033. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005963.

This report describes the 1985-1986 progress of the Magnetic Fusion Science Fellowship program (MFSF). The program was established in January of 1985 by the Office of Fusion Energy (OFE) of the US Department of Energy (DOE) to encourage talented undergraduate and first-year graduate students to enter qualified graduate programs in the sciences related to fusion energy development. The program currently has twelve fellows in participating programs. Six new fellows are being appointed during each of the program's next two award cycles. Appointments are for one year and are renewable for two additional years with a three year maximum. The stipend level also continues at a $1000 a month or $12,000 a year. The program pays all tuition and fee expenses for the fellows. Another important aspect of the fellowship program is the practicum. During the practicum fellows receive three month appointments to work at DOE designated fusion science research and development centers. The practicum allows the MFSF fellows to directly participate in on-going DOE research and development programs.

24193 **(DOE/OR/00033—T285) Fusion Energy Postdoctoral Research Program and Professional Development Program: FY 1986 annual report.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 23p. NTIS MF A01; 2; GPO Dep. File Number DE87006350.

During FY 1986, Oak Ridge Associated Universities (ORAU) initiated two new programs for the US Department of Energy (DOE), Office of Fusion Energy (OFE). The Fusion Energy Postdoctoral Research Program and the Fusion Energy Professional Development Program provide opportunities to conduct collaborative research in magnetic fusion energy research and development programs at DOE laboratories and contractor sites. Participants become trained in advanced fusion energy research, interact with outstanding professionals, and become familiar with energy-related national issues while making personal contributions to the search for solutions. Both programs enhance the national fusion energy research and development effort by providing channels for the exchange of scientists and engineers, the diffusion of ideas and knowledge, and the transfer of relevant technologies. These programs complement the Magnetic Fusion Energy Science and Technology Fellowship Programs already administered by ORAU for DOE/OFE.

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REFER ALSO TO CITATION(S) 23797, 23799, 24144, 24297, 24338

24194 **(DOE/ER/40091—T3) Colorado School of Mines fusion gamma ray project: Annual progress report.** Cecil, F.E. (Colorado School of Mines, Golden (USA). Dept. of Physics). 22 Dec 1986. Contract AC02-83ER40091. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006660.

A multifaceted study was made at PPPL of the gamma ray energy spectra and count rates on TFTR during Ohmic and neutral beam heated deuterium and ^{3}He plasmas. These measurements were made at neutron source strengths up to about 6 x 10^{15} neutrons per second during some of the record setting "super shots" achieved on TFTR during early July. During the course of a series of deuterium neutral beam heated ^{3}He plasmas, we observed the 16.6 MeV gamma ray from the d(^{3}He,γ)^{5}Li direct capture reaction using a large volume NE226 liquid scintillator detector. Preliminary measurements were made on TFTR of the flux of 14 MeV neutrons during deuterium discharges resulting from the burn-up of the 1 MeV tritons from the d-d reactions. The measured yield of the 14 MeV neutrons was found to be generally low when compared to the predicted yield. The use of alpha particle induced nuclear reactions as the basis of a diagnostic of fast confined and escaping alpha particles is described.

24195 **(DOE/ER/52127—11) Modeling and transport simulations of F - θ pumping in the RFP.** Scardovelli, R.A.; Nebel, R.A.; Werley, K.A.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.; Los Alamos National Lab., NM (USA)). 1986. Contract FG02-86ER52127. 28p. (CONF-860459—1-Vugraphs). NTIS, PC A03. File Number DE87006230.

From Sherwood theory meeting; New York, NY, USA (13 Apr 1986).

The necessity of m=1 modes for current drive has been shown in cylindrical geometry by using Faraday's and Ohm's laws and regularity conditions on the magnetic axis. An m=1 tearing mode that generates poloidal flux (necessary for current drive) has been identified in the form of an unstable off-axis parallel current peak. A 1-D analytical model based on the Kadomtsev reconnection model has been developed to describe the effects of this instability. A scoping of the F - θ space has been performed using a polynomial expansion for the parallel current profile, a linear resistive stability code and the 1-D reconnection model to find where this mode is unstable, the relative increase of poloidal flux and the size of the reconnecting region. A comparison between 1-D plasma transport simulations and the results from the F - θ pumping experiment, currently under way on ZT-40M at Los Alamos, will be presented.

24196 (EUR—9708-Vol.1, pp 13-38) **Resistively heated plasmas in JET: characteristics and implications.** Gibson, A. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A brief description is given of the JET tokamak experiment and its programme. The prospects for fusion research with JET are examined in the light of present tokamak experience and of the first data from JET itself. Initial results with ohmic plasmas in JET are presented and discussed.

24197 (EUR—9708-Vol.1, pp 39-66) **PPPL Tokamak program.** Furth, H.P. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The economic prospects of the tokamak are reviewed briefly and found to be favourable -- if the size of ignited tokamak plasmas can be kept small and appropriate auxiliary systems can be developed. The main objectives of the Princeton Plasma Physics Laboratory tokamak program are: (1) exploration of the physics of high-temperature toroidal confinement, in TFTR; (2) maximization of the tokamak beta value, in PBX; (3) development of reactor-relevant rf-techniques, in PLT.

24198 (EUR—9708-Vol.1, pp 67-96) **Confinement regimes in ohmically and auxiliary heated tokamaks.** Gruber, O. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The confinement behaviour of ohmically and beam heated tokamaks is described. Anomalous electron thermal transport is dominating in low density ohmic as well as "L" and "H" type beam heated plasmas. It leads however for these regimes to different scaling laws of both the local thermal conductivities and the global energy confinement times, which are derived from the results of numerous experiments. At high density ohmic discharges the neoclassical ion heat conductivity dominates the energy balance. Though the particle diffusion is anomalous, convective energy losses are small. Extrapolation to tokamak reactor systems indicates a necessity to reach the high confinement "H"-mode found in beam heated divertor tokamaks for achieving sufficiently high antin . tausub(E) values.

24199 (EUR—9708-Vol.1, pp 97-122) **Nature of disruptions.** Laurent, L. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Detailed investigations of the MHD activity during minor and major disruptions show clearly that the destabilization of several modes of different helicities causes a flattening of the electron temperature profile at the edge of the discharge. The transition from minor to major disruption is accompanied by an enhancement of the magnetic turbulence, while the energy confinement time decreases drastically. In both types of disruptions the presence of the ergodic zone seems to trigger an helical displacement of the hot region of the plasma which could be related to the temperature quenching in the discharge center. During the current quenching after a major disruption a part of the stored magnetic energy is dissipated in the center of a post-disruptive plasma. It is shown that the energy loss in the bulk of the plasma can be due to the presence of a significant magnetic turbulence ergodizing the magnetic field lines, while radiation and charge-exchange are dominant at the edge. The tokamak discharge then behaves as a natural ergodic divertor during the current quenching, provided the plasma discharge is clean enough so that the power balance at the plasma center is not dominated by impurity radiation.

24200 (EUR—9708-Vol.1, pp 123-154) **Observation of finite-β MHD phenomena in Tokamaks.** McGuire, K.M. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Stable high beta plasmas are required for the tokamak to attain an economical fusion reactor. Recently, intense neutral beam heating experiments in tokamaks have shown new effects on plasma stability and confinement associated with high beta plasmas. The observed spectrum of MHD fluctuations at high beta is clearly dominated by the $n = 1$ mode when the $q = 1$ surface is in the plasma. The $m/n = 1/1$ mode drives other $n = 1$ modes through toroidal coupling and $n > 1$ modes through nonlinear coupling. On PDX, with near perpendicular injection, a resonant interaction between the $n = 1$ internal kink and the trapped fast ions results in loss of beam particles and heating power. Key parameters in the theory are the value of qsub(o) and the injection angle. High frequency broadband magnetic fluctuations have been observed on ISX-B and D-III and a correlation with the deterioration of plasma confinement was reported. During enhanced confinement (H-mode) discharges in divertor plasmas two new edge instabilities were observed, both localized radially near the separatrix. By assembling results from the different tokamak experiments, it is found that the simple theoretical ideal MHD beta limit has not been exceeded.

24201 (EUR—9708-Vol.1, pp 157-175) **On the tokamak β - values limited by ideal MHD-stability.** Degtyarev, L.M.; Drozdov, V.V.; Martynov, A.A.; Medvedev, S.Y. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A numerical procedure for determining the tokamak plasma pressures limited by the ideal MHD stability is proposed. The limiting β - values are considered in dependence on the aspect ratio, the plasma cross-section geometry and the safety factor at the plasma boundary.

24202 (EUR—9708-Vol.1, pp 177-188) **Resistive MHD-equations for Tokamaks with arbitrary β and cross-section.** Elsaesser, K. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The complete set of hydromagnetic equations is transformed into potential form appropriate for numerical solution in toroidal

geometry. The magnetic quantities are described by the evolution equations for the poloidal and toroidal flux densities and a gauge variable; in order to reconstruct the poloidal vector potential with a certain boundary condition one has to solve two Poisson equations at every time step. A similar decomposition of the momentum balance equation is also obtained, leading to two additional Poisson equations for fluid potentials. Finally, the scaling laws previously used for the case of small toroidicity are found to require an artificial pressure law; the conclusion is then that up to now the nonlinear time-dependent hydromagnetic equations have not yet been properly solved in toroidal geometry.

24203 (EUR—9708-Vol.1, pp 189-205) **Resistive MHD modes and relaxation in Tokamak plasmas.** Kaw, P.K. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

In this paper we shall discuss two separate topics related to resistive MHD modes in tokamaks. In the first part we review some recent work on the stabilizing effect of temperature gradients and finite parallel electron thermal conductivity on resistive tearing and ballooning modes in a tokamak plasma. In the second half, we present a new model of relaxation of toroidal discharges, which is applicable to tokamaks.

24204 (EUR—9708-Vol.1, pp 209-224) **Effects of the alfven wave spectrum in heating experiments in TCA.** Appert, K.; de Chambrier, A.; Collins, G.A. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Reduction of the metallic impurity concentration in the TCA plasma has enabled us to correlate the observed heating with the calculated position where the RF energy is deposited. In modelling the measured antenna loading due to the presence of Alfven resonance surfaces, and hence inferring the energy deposition profile, both ion cyclotron effects and the toroidal geometry must be considered. In particular, toroidicity couples energy to resonance surfaces that would not be excited in cylindrical geometry. The increase in electron density during a RF pulse changes the positions of these surfaces so that spectrum-related effects may be observed. The appearance of a new surface at the centre of the plasma is seen as a sharp discontinuity on many of the macroscopic parameters, accompanied by evidence of changes in the current density profile. These results, and the predictions of numerical codes, have imposed new constraints on the optimisation of our antenna system.

24205 (EUR—9708-Vol.1, pp 225-245) **Experiments on lower hybrid current drive and heating on Petula B.** Melin, G.; Agarici, G.; Blanc, P. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The application of Lower Hybrid (LH) waves in Petula B has so far demonstrated the efficiency of ion heating, in D_2 plasmas. At low density, most of the plasma current can be replaced and a current drive efficiency etasub(CD)=1.5 10^{13} kA.cm^{-3}/kW is achieved at antinsub(e) < 1.8 10^{13} cm^{-3} in D_2 plasmas with a zero loop voltage. The paper gives a review of recent physics studies. For ion heating, the dependence of the heating with the density and the plasma current is presented. The limitations of the ion heating at high density and the impurity pollution are discussed. For HF current drive discharges, the HF current drive efficiency, the behavior of the fast electron population supporting the HF current are examined. Then a few results of the MHD activity studies and the stabilization effect of the HF power, and finally a tentative global energy balance of the HF sustained discharges, are presented.

24206 (EUR—9708-Vol.1, pp 247-258) **Consistent and non-consistent quasilinear models of lower-hybrid current drive.** Succi, S.; Vaclavik, J.; Appert, K. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Some theoretical aspects related to the problem of current generation by lower-hybrid waves are discussed. In particular, the influence of the spectral distribution of the rf power source and the effects of the anomalous Doppler interaction on the current generation are investigated.

24207 (EUR—9708-Vol.1, pp 259-270) **ECRH and plasma transport in T-10 Tokamak.** Alikaev, V.V.; Strelkov, V.S. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

In the experiments in T-10 ECRH of plasma was studied, when a position of the absorption zone at the cross-section of the plasma column was varied by a change in the magnetic field. The possibility of varying the temperature profile by variation in the position of a heated zone has been shown. Experiments on heating of the plasma with a density higher than the critical one, at the centre of the plasma column, have been done. A possibility of stabilizing or destabilizing MHD-oscillations is shown, when the power is deposited near the q=2 surface. A possibility of changing the electron temperature is used for the analysis of electron heat conduction dependence on temperature.

24208 (EUR—9708-Vol.1, pp 271-284) **Electron cyclotron resonance heating on the W VII A-stellarator.** Wilhelm, R.; Erckmann, V.; Janzen, G. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Plasma build-up and heating of OH-current free plasmas by ECR-wave irradiation were investigated on the WENDELSTEIN VII-A stellarator using three kinds of wave launching: direct irradiation of the gyrotron modes from the low field side, or advanced wave launching in 0-mode polarization from the low field side, the nonabsorbed fraction being reflected back to the plasma from the high field side in X-mode polarization. An increase of the central electron temperature from 0.7 keV (TE_{02} mode) to 1.2 keV (TE_{11}, HE_{11} mode) was observed which is explained by the narrow and well centred power deposition profiles for TE_{11}, HE_{11} modes. However, there is only a slight increase of the heating efficiency from 40% to 50%. The reflected X-mode fraction does not contribute to bulk plasma heating via Bernstein wave conversion and absorption as expected. The reason seems to be local absorption of the arising electron Bernstein waves due to a macroscopically turbulent structure around the upper hybrid resonance layer. Correlated with X-mode irradiation direct ion heating was observed (500

eV ion tail), possibly due to low frequency decay waves. In all ECRH experiments a toroidal plasma current was generated due to asymmetrically confined fast electrons. Optimum confinement in the shearless l=2 configuration was achieved at most irrational values of the rotational transform with small toroidal net current. It can be concluded from a numerical 1D-transport analysis that neoclassical electron confinement seems to be dominant in the hot central plasma core.

24209 (EUR—9708-Vol.1, pp 285-308) **Experimental studies of the plasma heating due to beam-induced turbulence.** Arzhannikov, A.V.; Burdakov, A.V.; Koidan, V.S.; Meshkov, O.I.; Postupaev, V.V.; Sinitsky, S.L.; Vyacheslavov, L.N. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The experimental results on plasma heating by virtue of a collective REB-plasma interaction are presented. The measured data concerning the energy and angular spread of the beam after its interaction with a plasma are given. These data enable one to estimate the energy density of resonance Langmuir oscillations. Heating of the bulk of plasma electrons has been studied by means of the 90° Thompson scattering. The total energy density of high-frequency oscillations has been estimated under the assumption that this heating occurs because of the collisional damping of Langmuir oscillations. Heating of the electrons with the energies E > approximately 0.5 keV has been analysed by means of the 8° Thompson scattering, X-ray diagnostics and multifoil analysis. The results obtained offer the possibility of determining the character of the distribution function of heated plasma electrons in a wide energy range: 0+100 keV. It is shown that the main fraction of the energy left by the REB in a plasma is delivered to the electrons with E < 10 keV. The latter are likely to be produced as a result of the collisionless damping of plasma waves with $\lambda \gg \omega$ p/C.

24210 (EUR—9708-Vol.1, pp 311-337) **Status of stellarator research.** Wobig, H. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

In recent years main activities in stellarator research were focussed on production and investigation of currentless plasmas. Several heating methods have been applied: electron cyclotron heating, ion cyclotron heating and neutral beam injection. The parameters achieved in HELIOTRON E and W VII-A are: antin <= 10^{20} m^3, Tsub(i) <= 1 keV. The confinement is improved as compared with ohmically heated discharges. By ECRH (P = 200 kW) it is possible to heat electrons up to 1.4 keV, confinement in this regime is dominated already by trapped particle effects. Toroidal currents up to 2 kA - either bootstrap currents or externally driven currents - were observed. High β-values (antiβ = 2%) have been obtained in HELIOTRON E, in this regime already pressure driven MHD-modes were observed. Future experiments (ATF-1 and W VII-AS) will extend the parameter regime to temperatures of several keV. These experiments will give important information about critical problems of the stellarator line (β-limit, neoclassical confinement impurity transport). A few reactor studies of stellarators exist, attention is mainly concentrated on technical problems of the modular coil system.

24211 (EUR—9708-Vol.1, pp 359-391) **Physics issues in mirror and tandem mirror systems.** Post, R.F. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Over the years the study of the confinement of high temperature plasma in magnetic mirror systems has presented researchers with many unusual physics problems. Many of these issues are by now understood theoretically and documented experimentally. With the advent of the tandem mirror idea, some new issues have emerged and are now under intensive study. These include: (1) the generation and control of ambipolar confining potentials and their effect on axial confinement and, (2) the combined influence of non-axisymmetric magnetic fields (used to ensure MHD stability) and electric and magnetic particle drifts on radial transport. Physics considerations associated with these two categories of issues will be reviewed, including concepts for the control of radial transport, under study or proposed.

24212 (EUR—9708-Vol.1, pp 393-415) **Recent experimental progress in the TMX-U thermal barrier tandem mirror experiment.** Turner, W.C.; Allen, S.L.; Casper, T.A. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Recent experiments on the TMX-U thermal barrier device at LLNL have achieved the end plugging of axial ion losses up to a central cell density of nsub(c) = 2 x 10^{13} cm. During these tests, the axial potential profile characteristic of a thermal barrier has been measured experimentally, indicating an ion-confining potential greater than 1.5 kV and a potential depression of 0.45 kV in the barrier region. The average beta of hot electrons in the thermal barrier has been increased to 15% and appears limited only by classical scattering and ECRH pulse duration. Furthermore, deuterium ions in the central cell have been heated with ICRF to an average energy of 1.5 keV, with a heating efficiency of 40%. During strong end plugging, the axial ion confinement time reached 50 to 100 ms while the nonambipolar radial ion confinement time was 5 to 15 ms--independent of end plugging. Radial ion confinement time exceeding 100 ms has been attained on shots without end plugging. Plates, floated electrically on the end walls, have increased the radial ion confinement time by a factor of 1.5.

24213 (EUR—9708-Vol.1, pp 417-453) **Physics of Reversed Field Pinch.** Bodin, H.A.B. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion Programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Taylor's theory of relaxed states, which defines relaxed Reversed Field Pinch equilibria independently of the mechanism of relaxation is briefly reviewed. An account is then given of a number of mechanisms put forward to explain relaxation and reversed field generation, processes which can also lead to anomalous transport. Finally, studies of fluctuations in the HBTX1A Reversed Field Pinch using edge coils, insertable probes and surface barrier diode X-ray detectors are described in which a variety of unstable modes are identified. The questions of the origin of these modes, their possible role in relaxation and field generation and their effect on transport is discussed in a preliminary fashion.

24214 **(EUR—9708-Vol.1) Proceedings of the 1984 International Conference on plasma physics.** Tran, M.Q.; Verbeek, R.J. (eds.). (Commission of the European Communities, Luxembourg). 1985. 549p. (CONF-840616—Vol.1). NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134.

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The 1984 ICPP, held in Lausanne, Switzerland, is the third biennial conference of the series "International conferences on plasma physics". A complete spectrum of current plasma physics from fusion devices to interstellar space was presented, even if most of the papers were of direct interest for fusion. The conference stressed the important role that "basic plasma physics" must play in fusion research. Recent theoretical and experimental developments in tokamaks, stellarators, mirrors, reversed field pinches, and other fusion devices were reported. The successful operation of two newly-built large tokamak devices, JET and TFTR, holds the promise that a host of new results of decisive importance for fusion research will become available in the next few years. This is the first part of the conference.

24215 (EUR—9708-Vol.1, pp 455-471) **Physics of Reversed-Field Pinch profile sustainment.** Moses, R.W. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A description of the Reversed-Field Pinch (RFP) is given. There is experimental evidence that indicates that an RFP dynamo effect sustains field reversal in steady state. Three sustainment mechanisms are reviewed: the MHD model, the tangled discharge model, and the kinetic dynamo model. The relationship of these models to each another is discussed briefly.

24216 (EUR—9708-Vol.1, pp 473-495) **Rotating magnetic field technique of driving current and its application in the Rotamak.** Jones, I.R. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Two topics are discussed in this paper: the rotating magnetic field method of driving plasma current and its application in the generation of a compact torus configuration known as the Rotamak. In the discussion of the rotating magnetic field technique, the conditions necessary for the achievement of current drive are listed and a description is given of the basic physical mechanism underlying the method. A general description of a typical Rotamak device is provided together with results obtained in a high power (12 MW), short duration (approximately 80 μsec) experiment and a new, moderately high power (180 kW), long duration (40 msec) experiment. In both experiments, stable compact torus equilibria are produced in a straightforward manner.

24217 (EUR—9708-Vol.1, pp 499-513) **Comparison of electrical conductivities derived from measured current density distributions and electron temperature profiles in the TEXTOR Tokamak.** Soltwisch, H.; Graffmann, E.; Schlueter, J.; Waidmann, G. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Radial profiles of the electrical conductivity in TEXTOR were determined independently from experimental Tsub(e)-profiles and Zsub(eff)-distributions using Spitzer's formula and neoclassical theory, and from measured current density profiles and the loop voltage. A detailed comparison of the results clearly favours neoclassical theory over pure Spitzer conductivity, although the combined errors of the measurements prevent an unambiguous decision. Tsub(e)-profiles were obtained by observing the soft X-ray continuum radiation simultaneously along five chords and by Thomson scattering at seven points of the vertical plasma diameter. In addition Tsub(eo) was measured continuously by electron cyclotron emission diagnostics. Zsub(eff)-values at three radial positions were determined from soft X-ray line and continuum intensities. Currrent density distributions and nsub(e)-profiles were derived from phase shift and Faraday rotation measurements using a nine-channel far-infrared interferometer/polarimeter.

24218 (EUR—9708-Vol.1, pp 515-533) **Two novel plasma diagnostic tools: fiber sensors and phase conjugation.** Jahoda, F.C. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A rapidly developing technology (single-mode optical fiber sensors) and recent fundamental research in nonlinear optics (phase conjugation) both offer opportunities for novel plasma diagnostics. Single-mode fiber sensors can replace electrical wire probes for current and magnetic field measurements with advantages in voltage insulation requirements, electromagnetic noise immunity, much greater bandwidth, and some configuration flexibility. Faraday rotation measurements through fibers wound on the ZT-40M RFP have demonstrated quantitative results, but competing linear birefringence effects still hinder independent interpretation. Twisted fiber may solve this problem. Optical phase conjugation (in which a phase reversed copy of a laser beam is generated) allows real time distortion corrections in laser diagnostics. Self-pumped phase conjugation in $BaTiO_3$ improves the quality of phase conjugation imagery and greatly simplifies experimentation directed toward plasma diagnostics. Our initial applications are a) time-differential refractometry with high spatial resolution and b) intracavity absorption Zeeman spectroscopy.

24219 (EUR—9708-Vol.1, pp 535-546) **Enhanced microwave scattering and its application for plasma diagnostics.** Piliya, A.D. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A23/MF A01. File Number DE87751134. (CONF-840616—Vol.1).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A diagnostic method based on microwave scattering from a hybrid resonance region is discussed. Experiments using this method for study of a parametric instability in an inhomogeneous plasma and for detecting lower hybrid wave are presented.

24220 **(EUR—9708-Vol.2) Proceedings of the 1984 international conference on plasma physics.** Tran, M.Q.; Verbeek, R.J. (eds.). (Commission of the European Communities, Luxembourg). 1985. 611p. (CONF-840616—Vol.2). NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132.

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The 1984 ICPP, held in Lausanne, Switzerland, is the third biennial conference of the series "International conferences on plasma physics". A complete spectrum of current plasma physics from fusion devices to interstellar space was presented, even if most of the papers were of direct interest for fusion. This is the second part of the conference.

24221 (EUR—9708-Vol.2, pp 555-574) **Formation of electrostatic potential in a magnetized plasma.** Sato, N. (Tohoku Univ., Sendai, Japan. Dept. of Electronic Engineering). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

A short review is presented of some recent basic laboratory experiments on formation of electrostatic potentials in strongly magnetized plasmas. A special emphasis is on electric double layers and related dynamics of potential wells formed in a nondischarge collisionless plasma. A magnetic mirror is found to have a big effect on the double layers. The V(or U)-shape double layer is shown to be responsible for generation of electrostatic instabilities around harmonics of ion cyclotron frequency. A stable potential well, so called "thermal barrier", is demonstrated to be formed between two plasmas with different electron temperatures. A few remarks are also made on preliminary measurements of electrostatic potentials formed in a plasma flowing along mirror-type configurations of magnetic field.

24222 (EUR—9708-Vol.2, pp 575-592) **Convective cell experiments.** Sugai, H. (Nagoya Univ., Japan. Dept. of Electrical Engineering). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

External excitation of convective cells is performed both in a fully ionized plasma(Q-device) and in a steady-state toroidal plasma. Field-aligned absorption or injection of electrons by external pulses gives rise to the convective cells with positive or negative polarity. The space-time evolution of convective cells is investigated by two-dimensional potential mapping. A positive convective cell formed in a plasma flow is observed to drift, to elongate by the velocity shear, and to yield a new negative cell. Effects of ion viscosity on the damping and the size of convective cells are found in an endless "toroidal" convective cell. The other damping processes such as geometrical damping, turbulent damping, ion-neutral collisions, end effects are discussed. Cell-cell interactions are investigated by exciting two cells simultaneously. A possibility of coalescence of two cells with same polarity is demonstrated.

24223 (EUR—9708-Vol.2, pp 593-624) **Experiments on Langmuir wave collapse.** Wong, A.Y.; Cheung, P.Y. (California Univ., Los Angeles, USA. Dept. of Physics). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

We present experimental evidence of Langmuir collapse, an important process in the hierarchy of highly nonlinear plasma interactions. The primary Langmuir wave was excited by a cold electron beam in a homogeneous plasma. The temporal and spatial development of the collapse process is described with quantitative comparison against theoretical predictions of collapse rate and threshold. Bursts of electrostatic and electromagnetic waves support the picture of collapse and their detailed frequency spectra agree with the growth of density cavities. New data on spatial and temporal recurrence in such strongly turbulent systems are presented, the recurrent period being determined by the ion density relaxation time. Finally the probable roles of cavitons and clumps are discussed and new kinetic effects are proposed to complete our understanding of the nonlinear hierarchy.

24224 (EUR—9708-Vol.2, pp 625-640) **Soliton resonance and related phenomena in plasmas.** Yajima, N. (Kyushu Univ., Kasuga, Japan. Research Institute for Applied Mechanics). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Summary report is presented to recent advancements in soliton research in plasma physics. Especially, the resonance phenomena in two dimensional interaction of ion-acoustic solitons and the nonlinear coupled explosive mode of slow ion-acoustic wave in an ion-beam plasmas are discussed.

24225 (EUR—9708-Vol.2, pp 641-663) **Harmonic emission from the quarter critical density surface of laser-produced plasmas.** Barr, H.C. (Wales Univ., Bangor, UK). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Harmonic emission at one half or three halves the laser frequency is evidence for the generation of plasmons near the quarter critical density surface. Such electron plasma waves are generated by either the Raman of two-plasmon decay instabilities. Observations show characteristic double peaked spectra at both harmonics for which there exist a variety of interpretations.

24226 (EUR—9708-Vol.2, pp 665-678) **Gyrotrons and plasma investigations.** Goldenberg, A.L.; Litvak, A.G. (Academy of Sciences of the USSR, Gorky). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The powerful millimeter-wave radiation of gyrotrons possesses some properties owing to which new plasma investigations have been started. Gyrotrons provide plasma heating at electron-cyclotron resonance, as well as pre-ionization and plasma diagnostics in large nuclear fusion installations. The wave beams of millimeter-wave radiation of gyrotrons are applied for studying the phenomena of gas discharge and thermal self-focusing and clearing in plasma. The results of the investigations are discussed.

24227 (EUR—9708-Vol.2, pp 735-759) **Waves in plasmas: some historical highlights.** Stix, T.H. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

To illustrate the development of some fundamental concepts in plasma waves, a number of experimental observations, going back over half a century, are reviewed. Particular attention is paid to the phenomena of dispersion, collisionfree damping, finite-Larmor-radius and cyclotron and cyclotron-harmonic effects, nonlocal response, and stochasticity. One may note not only the constructive interplay between observation and theory and experiment but also that major advances have come from each of the many disciplines that invoke plasma physics as a tool, including radio communication, astrophysics, controlled fusion, space physics, and basic research.

24228 (EUR—9708-Vol.2, pp 761-783) **Intrinsic stochasticity.** Chirikov, B.V. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Selected topics in the theory of dynamical chaos in Hamiltonian systems are discussed, including the nature and mechanism of the chaos as well as its peculiar statistical properties in presence of the chaos border with a critical scale-invariant structure. As an example, two simple models described by two-dimensional mappings are considered.

24229 (EUR—9708-Vol.2, pp 785-815) **Behavior of orbits of two coupled oscillators.** Greene, J.M. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

There has been very considerable progress in the past few years on the theory of two conservative, coupled, nonlinear oscillators. This work also applies to many equivalent systems, so it has applications to particle containment and heating, for example, and wherever else in plasma physics that the validity of adiabatic invariants is a matter of concern. A general problem of this class has a solution that is so complicated that it is impossible to find an expression for the state of the system that is valid for all time. However, recent results are making it possible to determine the next most useful type of information. This is the asymptotic behavior of individual orbits in the limit of very long times. This is just the information that is desired in many situations. For example, it determines the stability of the motion. The key to our present understanding is renormalization. The present state of the art has been described in Robert Mackay's thesis, for which this is an advertisement.

24230 (EUR—9708-Vol.2, pp 837-853) **Beat Wave and Surfatron Accelerator of particles.** Dawson, J.M. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The possibility of using intense plasma waves to accelerate particles to high energy is discussed. This is of interest because of the very intense electric fields that can be generated and the fact that the phase velocity can be essentially the speed of light. Particular attention is given to generating the waves by two intense laser beams with frequency difference equal to the plasma frequency (Beat Wave Accelerator) and using magnetic fields to maintain phase coherence of the accelerated particles with the plasma wave (Surfatron Accelerator). Results of extensive numerical simulation are given. Some of the advantages, disadvantages and important questions for these acceleration mechanisms are discussed.

24231 (EUR—9708-Vol.2, pp 855-875) **Wave particle interactions and plasma turbulence theory.** Laval, G.; Pesme, D. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

An introduction to several theories describing wave-particle interactions is presented; various concepts corresponding to different issues are made precise, namely resonant particles interaction with normal modes or ballistic modes, weak and strong nonlinear effects, quasi-Gaussian or self-consistent field theories, weak coupling of linear or nonlinear objects. The specific features of the clump theory and of the turbulent trapping model are displayed with a particular emphasis on their respective domain of applicability; their connection with the direct interaction approximation is discussed.

24232 (EUR—9708-Vol.2, pp 877-904) **Double stimulated scattering and the development of the theory of parametric instabilities in plasmas.** Silin, V.P.; Tikhonchuk, V.T. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The coherent structure of electromagnetic fields in plasma in the reason of for the new features of parametric instabilities. Such coherent structure connected with the reflection surface of the electromagnetic waves produces the distributed feedback. Because of this feedback the number of the interacting electromagnetic waves in the processes of stimulated scattering in twice more than usually. Such double stimulated scattering processes are connected with absolute parametric instabilities. The examples of double stimulated Mandelstam-Brillouin scattering, double combination (Raman) scattering and parametric decay are discussed.

24233 (EUR—9708-Vol.2, pp 905-920) **Anomalous plasma resistivity and ion-acoustic turbulence.** Silin, V.P. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Short review is given of the analytical theory of ion-acoustic turbulence that takes into account the stimulated ion wave scattering by the ions as a non-linear effect and the quasilinear electron scattering by the ion-acoustic turbulent fluctuations. Such theory gives the description of the quasistationary plasma state with moderate level of turbulent pulsations and anisotropic electron distribution. The theory permits to obtain the anomalous laws for the electron current, for the electron heat flux and for electron temperature relaxation. The role of the symmetric part of the electron distribution function is discussed. Our theory describes the switch off the anomalous resistivity in the strong magnetic field limit.

24234 (EUR—9708-Vol.2, pp 921-946) **Renormalized theory of nonlinear fluctuations and plasma turbulence.** Sitenko, A.G.; Sosenko, P.P. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

The general statistical approach is applied to derive basic equations of the renormalized statistical theory describing plasma turbulence. Second- and third-order terms with respect to the fluctuation intensity are taken into account. Both potential and nonpotential electromagnetic fluctuations are considered. Response functions and the nonlinear dielectric permittivity of the plasma are found. The equations are factorized and thus the collective effects are separated out. The passage to the weak-turbulence limit is discussed. The fluctuation-dissipation theorem is formulated in terms of the renormalized quantities. The general formalism is applied to describe low-frequency plasma excitations under the influence of a strong magnetic field. Stationary spectra of convective and drift excitations are calculated for various turbulent regimes and anomalous transport coefficients are found.

24235 (EUR—9708-Vol.2, pp 947-961) **Thermal electrons transport in the presence of strong temperature gradients.** Virmont, J.; Luciani, J.F.; Mora, P. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

When the temperature gradient is too strong, the classical theory of heat transport breaks down, because it is only a first order expansion. This is the case in several experimental situations of present interest, particularly in laser-irradiated targets, where there are strong electron temperature gradients. It is well known that, in the specific case of electrons, the classical theory is limited to very small values of the ratio between the electron mean free path and the temperature gradient length. We show that a "non local" description, based on the P_1 approximation, holds over the next decade. The existence of this intermediate regime, before the very complicated "kinetic" situation, is characteristic of electrons and is due to the preponderance of small angle scattering. In many cases, the approximation of a quasi-steady-state still can be done, which further simplifies the solution. In this regime, the convolution of the Spitzer heat flow by a "delocalisation function" is shown to fit well the simulation results, and can be justified as the right approximation. This formulation can be easily incorporated into fluid codes.

24236 (EUR—9708-Vol.2, pp 963-993) **Nonlinear driven reconnection.** Sato, T. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Characteristics of driven reconnection are explained with emphasis on the distinction from spontaneous reconnection. Numerical simulations indicate that driven reconnection is almost independent of resistivity but is largely controlled by driving plasma flow, this making a clear contrast with spontaneous reconnection. Four different examples of driven reconnection are studied by 3D MHD simulations. The first one is the case where two identical plasmas with anti-parallel fields are driven to collide in an open system. A typical example is the stretched magnetotail neutral sheet. Simulations indicate that slow mode shocks are formed whereby plasma is explosively accelerated. The second example is the case where a high-beta plasma collides against a low-beta plasma with an arbitrary field angle. The solar wind-magnetosphere interaction is a typical example - Results indicate that no prominent plasma acceleration is observed in this case but the high-beta plasma continuously erodes the low-beta plasma. The fine structure in the vicinity of the reconnection line is disclosed. The third example is the merging process of two spheromaks. It is shown that merging is an energy relaxation process. The final example is the self-reversal process in the reversed field pinch. It is shown that the self reversal is a relaxation process caused by nonlinear driven reconnection.

24237 (EUR-CEA-FC—1295, pp 49-52) **Suppression of sawtooth oscillations by Lower Hybrid Current Drive in the Petula-B tokamak.** Van Houtte, D.; Agarici, C.; Bottollier-Curtet, H. (Association EURATOM-CEA CEN Grenoble, 38, France. DRFC/SJG). May 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751062. (CONF-860412—).

From 13. European conference on controlled fusion and plasma heating; Schliersee, F.R. Germany (14 Apr 1986).

Powerful additional heating experiments on large tokamaks have shown limitations of performances due to the presence of internal disruptions. Thus, since the early work of the Petula Group on the low-m tearing mode stabilization (van Houtte et al, 1984), the Lower Hybrid Current Drive (LHCD) experiments are mainly aiming at the suppression of sawtooth instabilities which exist in inductively driven discharges.

24238 (EUR-CEA-FC—1295, pp 25-28) **Lower hybrid current drive efficiency of the Petula-B tokamak at f = 1.3 GHz and at f = 3.7 GHz.** Gormezano, C.; Hoang, G.T.; Agarici, G. (Association EURATOM-CEA, CEN Grenoble, 38, France. Dept. de Recherches sur la Fusion Controlee). May 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751062. (CONF-860412—).

From 13. European conference on controlled fusion and plasma heating; Schliersee, F.R. Germany (14 Apr 1986).

Current drive experiments are made in the Petula-B tokamak by means of a 1.3 GHz generator and a 3.7 GHz generator. Density limits are given; comparison between efficiencies at these two frequencies is given. Power dependence of efficiency for 3.7 GHz is studied.

24239 (IA—1421, pp 42) **Autoresonance laser accelerator.** Loeb, A.; Friedland, L. (Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

24240 (IA—1421, pp 43) **Self-consistent solution for the nonlinear dynamics of dense electron beams in the autoresonance laser accelerator.** Loeb, A.; Friedland, L. (Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

24241 (IA—1421, pp 43) **Effect of plasma oscillations on the radiation profile of the immersed ions in plasma.** Strauss, M.; Hayrapetian, A.; Daghighian, F.; Rostoker, N. (Israel Atomic Energy Commission, Tel Aviv; California Univ., Irvine, USA). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

24242 (IA—1421, pp 45) **Spallation and dynamic fracture as an effect of laser induced shock waves.** Salzmann, D.; Gilath, I.; Paiss, Y.; Dariel, M.; Bar-Noy, T.; Kornblit, L. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

24243 (IAEA-CN—47/F-IV-4) **Recent advances in the theory and modeling of rf heating in inhomogeneous plasmas.** Swanson, D.G.; Cho, S.; Phillips, C.K.; Hwang, D.Q.; Houlberg, W.; Hively, L. (Auburn Univ., AL (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; California Univ., Davis (USA). Dept. of Applied Science; Oak Ridge National Lab., TN (USA)). 1986. Contract FG05-85ER53192;AC05-84OR21400. 32p. (CONF-861106—23-Trans.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006664.

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

The following studies are briefly described: (1) three wave mode coupling near lower hybrid resonance, (2) exact order reduction in mode conversion problems, (3) two-dimensional conversion-parabolic approximation and (4) transport simulations of icrf-heated tokamaks. (MOW)

24244 (IC—86/169) Theoretical study of electrical breakdown in nitrogen induced by laser radiation at 1.06 μm. Gamal, Y.E.E.D.; Abdel-Moneim, N.M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701527.

The electron cascade model originally proposed by Evans and Gamal to study atomic gas breakdown is extended to molecular gas breakdown calculations, including molecular electronic excitations and vibrational excitation effects. The validity of this model is studied for nitrogen at pressures ranging from 7.6 x 10/sup 2/ to 3.3 x 10/sup 4/ Torr irradiated by laser radiation of wavelength 1.06 μm and 10 ns pulse duration. The calculated threshold intensities are in good agreement with the experiment. Calculations of the electron energy distribution function have also been performed to reflect the important electron-molecule energy exchange processes in molecular gases. 10 refs, 5 figs, 2 tabs.

24245 (IC—86/173) Electron-ion two-stream instability in anisotropic isothermal plasma. Khalil, Sh.M.; Mohamed, B.F. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701528.

The linear excitation of electron-ion two-stream instability excited in inhomogeneous, magnetized isothermal plasma (T/sub e/ =T/sub i/) is investigated analytically. Expressions for the frequency, growth rate and conditions of instability are obtained when the current velocity slightly exceeds the instability threshold velocity. Inhomogeneity in density and existence of external static magnetic field may stabilize the instability. 14 refs.

24246 (IC—86/186) Buneman instability in hot electron plasma (T/sub e/>>T/sub i/). Khalil, S.M.; Sayed, Y.A.; Sayed, R.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701532.

We shall investigate the linear excitation of electrostatic current Buneman instability in both unmagnetized and magnetized homogeneous plasma. The frequency, growth rate and conditions of excitation of such instability are obtained analytically. We consider that the current velocity u (due to relative streaming of ions and electrons) slightly exceeds the instability threshold velocity u/sub cr/ and that the electron temperature is much higher than the ion temperature (T/sub e/>>T/sub i/). 11 refs.

24247 (INIS-SU—384, pp 38-42) **Short-wave ion-acoustic turbulence and anomalous transport in a plasma.** Silin, V.P. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780105.

Kratkie Soobshcheniya po Fizike.; No. 6.

In Experimental and theoretical physics. Collection.

For small turbulent Knudsen numbers two approximations which allow assumption of analytical description of ion-acoustic turbulence, describing short-wave pulsations and refinement of anomalous transport coefficients, are proposed.

24248 (INIS-SU—384) Experimental and theoretical physics. Collection. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. 53p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780105.

Kratkie Soobshcheniya po Fizike.; No. 6.

Separate abstracts were prepared for each of the included papers. (MOW)

24249 (INIS-SU—399, pp 9-11) **Ion acceleration during strong electromagnetic radiation interaction with a plasma.** Bulanov, S.V.; Sasorov, P.V. (AN SSSR, Inst. Obshchej Fiziki; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780091.

Kratkie Soobshcheniya po Fizike.; No. 4.

In Experimental and theoretical data. Collection.

Equations described a nonlinear stage of a long-wave aperiodic parametric plasma instability in the SHF-field are obtained. Exact solutions of this equations reveal a possibility of generation of fast ion groups. Energy spectra and maximum energies of accelerated particles are defined. 12 refs.

24250 (INIS-SU—401, pp 27-32) **To the nonlinear theory of travelling electromagnetic waves in a moving plasma.** Silin, P.V. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

Analytic theory of transition from supersonic plasma flow to subsonic one for a case of travelling wave where the electromagnetic field energy flow along the OX axis differs from zera is presented. It is supposed that radiation may be absorped within the plasma, and in the irradiating zone absorption is absent.

24251 (IPPJ—757) Active diagnostics of magnetically confined alpha particles by pellet injection. Sasao, M.; Sato, K.N.; Nakamura, Y.; Wakatani, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701580.

Confined alpha-particle diagnostics by a pellet injection is proposed. The alpha-particle density can be obtained from the number of decaying photons emitted from He/sup +/* (n ≦ 2) ions which are produced through the one-electron transfer reaction of an alpha-particle from the probing ion ablated from the pellet before it is fully ionized. The counting rate estimated with theoretical cross sections and the calculated pellet ablation rate is sufficient for the observation under the bremmstrahlung background. The alpha-particle velocity distribution will be also obtained from the Doppler broadening of the spectral lines.

24252 (LRP—252/84) TCA papers presented at 4th international symposium on heating in toroidal plasmas. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Oct 1984. 42p. (CONF-840311—Exc.). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900202.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Separate abstracts were prepared for each of the included papers. (MOW)

24253 (LRP—252/84, pp H.1-H.15) **Alfven wave heating on TCA.** de Chambrier, A.; Collins, G.A.; Duperrex, P.A.; Heym, A.; Hofmann, F.; Hollenstein, C.; Joye, B.; Keller, R.; Lietti, A.; Lister, J.B. (Ecole Polytechnique Federale de Lausanne, Switzerland; Univ. of Fribourg, Switzerland; Univ. of Zurich, Switzerland). Oct 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900202. (CONF-840311—Exc.).

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Recent results of Alfven wave heating in the TCA Tokamak are briefly reviewed. Measurements of the electron temperature and electron density in the TCA scrape-off layer during high power rf heating are presented in detail. It is found that antenna-plasma interaction may lead to a non-Maxwellian edge plasma. Its impact on the interpretation of the edge measurements and the antenna and screen design are discussed.

24254 (SAIC—86/1904-Rev.) Beating a dead horse with a red herring. Catto, P.J. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Feb 1987. Contract AC03-76ET53057. 12p. (PRI—105-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006576.

An alternate banana regime evaluation of the ion heat flux in tokamaks demonstrates that the neoclassical ion thermal conductivity in the large aspect ratio limit is slightly more than twice the accepted value. Furthermore, the arbitrary aspect ratio expression is evaluated and found to be different than previously conjectured.

24255 **(SAIC—87/1559) Evaluation of the slowing down tail enhanced, neoclassical alpha particle energy flux.** Catto, P.J. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Feb 1987. Contract AC03-76ET53057. 17p. (PRI—109). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006577.

The non-Maxwellian slowing down tail formed by the energetic alpha particles produced in a fusing tokamak is shown to substantially enhance the neoclassical radial energy loss of alphas. The retention of the pitch angle scattering of the energetic tail alphas by the background ions leads to a neoclassical energy flux that can easily become comparable to that of the alpha ash. Fortunately, only a small fraction of the fusion alpha power is lost because of this enhanced energy diffusion.

24256 **(TRITA-PFU—85-10) Hall effect upon small wavelength kink instabilities near an elliptic magnetic stagnation line.** Spies, G.O.; Faghihi, M. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). [1986]. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750909.

To explore the question whether the Hall effect removes the unphysical feature of ideal magnetohydrodynamics of predicting unstable small wavelenght kinks near any elliptic magnetic stagnation line, a spectral analysis is performed of the motion of an incompressible plasma about cylindrical Z-pinch equilibria with circular sections. The eigenvalue loci in the complex frequency plane are derived for the equilibrium with constant current density. These show that every particular mode becomes stable as the Hall parameter exceeds a critical value. However, this critical value is a decreasing function of the ideal growth rate and has a pole at the origin, implying that there always remains an infinite reservoir of slowly growing instabilities. Correspondingly, for equilibiria with arbitrary current distributions, the stability criterion is unaffected by the Hall term.

24257 **(TRITA-PFU—86-05) Effects of pressure anisotropy on the M=1 small wavelenght modes in Z-pinches.** Faghihi, M. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). May 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750907.

A new model is used to investigate the effect of the pressure anisotropy on the internal kink (M=1) mode instability in a Z-pinch. A normal mode analysis of perturbed motion of an incompressible, collision- less and cylindrical plasma is performed. A comparison of the derived stability criterion with that of ideal MHD is made. The conclusion is that the stability criterion (rSigmaB/sp2/) '<0 can not be fullfilled without violation of the fire house condition Sigma>0, where Sigma=1-(P/sb/(parall)-P/sb/(perpend)/ B/sp/2.

24258 **(TRITA-PFU—86-06) Plasma stabilization and heating by induced currents along a poloidal magnetic field.** Brunsell, P.; Tennfors, E. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). 25 Jun 1986. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750908.

The stabilizing and heating effects of induces low frequency poloidal currents in the internal ring device F IV A are studied. Density fluctuations are stabilized already at a low power poloidal currents. At higher levels the temperature is increased. The start-up processes seem more efficient than without poloidal currents. Preliminary experiments at lower filling pressures indicate that a more quiescent plasma with higher temperature is produced.

24259 **(UPTEC—8613R) MHD stability properties of Extrap.** Ring, R. (Uppsala Univ. (Sweden). Inst. of Technology). 27 Mar 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750902.

Stability properties of an Extrap with N conductors are investigated. The plasma is described by the ideal MHD model, the surface current model is used and the noncircularity is assumed to be weak. The investigation is carried out to second order in a small parameter /EPSILON/ that is a measure of the noncircularity of the cross section. As expected it turns out that the degeneracy present in the circular case is removed to first order in /EPSILON/ for m=N/2 and to second order for m=N, m beeing the azimuthal mode number. For other m values the degeneracy prevails but the eigenfrequences are shifted. It is also found that the sausage modes are stabilized for wave- lengths longer than the circumference of the pinch, that some other modes are stabilized for short waves and that the non- circularity causes resonant coupling between certain modes.

24260 **(UPTEC—85117R) Self-similar drift waves in two dimensions.** Nycander, J.; Taranov, V.B. (Uppsala Univ. (Sweden). Inst. of Technology). Nov 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750698.

The possibility of self-similar non-linear driftwaves is shown, and an exact expression describing them in the linear limit is obtained. It is demonstrated numerically that they describe the tail that appear during solition formation.

24261 **Plasma-materials interactions test facility.** Uckan, T. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **58**: No. 1, 17-19(Jan 1987). Contract AC05-84OR21400.

The Plasma-Materials Interactions Test Facility (PMITF) recently designed and constructed at Oak Ridge National Laboratory (ORNL) is an electron cyclotron resonance microwave plasma system with densities around $10^{11}cm^{-3}$ and electron temperatures of 10—20 eV. The device consists of a mirror cell with high-field-side microwave injection and a heating power of up to 0.8 kW (cw) at 2.45 GHz. The facility will be used for studies of plasma-materials interactions and of particle physics in pump limiters and for development and testing of plasma edge diagnostics.

24262 **Magnetohydrodynamic stability of plasmas with aligned mass flow.** Tataronis, J.A.; Mond, M. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 1, 84-89(Jan 1987).

The linear magnetohydrodynamic stability of plasmas with sub-Alfvenic flows aligned parallel to the equilibrium magnetic field is treated. Subject to the constraints that the fluid is incompressible, inviscid, and perfectly conducting, it is demonstrated that stabilizing effects appear as the flow speed approaches the Alfven speed. The screw pinch plasma is treated explicitly, but it is conjectured that the conclusions are applicable to other equilibrium configurations.

24263 **F-θ pumping with partial relaxation.** Strauss, H.R.; Harned, D.S. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **30**: No. 1, 164-167(Jan 1987).

F-θ pumping is studied in a 1-D model including the hyperresistivity caused by tearing mode turbulence. When the hyperresistivity is sufficiently large compared to the resistivity, a positive, although time-varying, toroidal current can be maintained without a net toroidal voltage. For less hyperresistivity, the toroidal current periodically changes sign.

24264 **Propagation of a nonrelativistic electron beam in a plasma in a magnetic field.** Okuda, H.; Horton, R.; Ono, M.; Ashour-Abdalla, M. (Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, New Jersey 08544). *Physics of Fluids;* **30**: No. 1, 200-208(Jan 1987).

Propagation of a nonrelativistic electron beam in a plasma in a strong magnetic field has been studied using electrostatic one-dimensional particle simulation models. Electron beams of finite pulse length and of continuous injection are followed in time to study the effects of beam—plasma interaction on the beam propagation. For the case of pulsed beam propagation, it is found that the beam distribution rapidly spreads in velocity space generating a plateaulike distribution with a high energy tail extending beyond the initial beam velocity. This rapid diffusion takes place within a several amplification length of the beam—plasma instability given by (ω/sub p/ω^2/sub b/) $^{-1}$/sup //$^3V_0$, where ω/sub p/, ω/sub b/, and V_0 are the target plasma, beam—plasma frequencies, and the beam drift speed. This plateaulike distribution, however, becomes unstable as

the high energy tail electrons free-stream, generating a secondary beam. A similar process is observed to take place for the case of continuous beam injection when the beam density is small compared with the total density n/sub b//n/sub t/<1. In particular, the electron velocity distribution is found monotonically decreasing in energy, having a high energy tail whose energy reaches twice the initial beam energy. Such an electron distribution is also seen in laboratory experiments and in computer simulations performed for a uniform, periodic system.

24265 **Reconstruction of plasma radiation features from projections measured with two bolometer arrays.** Schivell, J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 1, 12-16(Jan 1987).

A specialized method has been developed to maximize the two-dimensional detail obtained from two perpendicular bolometer arrays. The technique relies on the assumption that poloidal variation exists only near the plasma surface. The cross section is divided into appropriate zones and the emittance is reconstructed by a numerical method. The position, intensity, and width of large features are clearly displayed. A marfe is tracked as it drifts around the plasma and evolves into a radiating shell detached from the limiter. A central peak, plus inner-wall radiating layer, plus a marfe appear in a high-density case reached by pellet injection.

24266 **Simple system for mapping magnetic field errors in tori.** Bellan, P.M. (California Institute of Technology, Pasadena, California 91125). *Review of Scientific Instruments;* **58**: No. 1, 148-149(Jan 1987).

A simple inexpensive electron beam/detector system is described. This system is capable of making vector maps of magnetic field errors over the minor cross section of toroidal plasma devices.

24267 **Destabilization of Alfven-resonant modes by resistivity and diamagnetic drifts.** Aydemir, A.Y.; Hazeltine, R.D.; Meiss, J.D.; Kotschenreuther, M. (Institute for Fusion Studies, University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 1, 4-6(Jan 1987).

The existence of unstable resistive drift-Alfven modes is shown in a cylindrical geometry. The modes, driven by nonuniformities in the diamagnetic drift frequency, are unstable even when the associated purely resistive mode is stable. The growth rate has a weak, eta^{1}/sup //^{4}, dependence on resistivity. Because of their large growth rates, they may play an important role in tokamak confinement.

24268 **Analytical theory of nonlinear drift-tearing mode stability.** Scott, B.D.; Hassam, A.B. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **30**: No. 1, 90-101(Jan 1987).

An analytical theory of the nonlinear stability of drift-tearing modes in the semicollisional regime is presented. It is shown that the overall stability depends critically on the initial island width and the plasma beta. Linear and quasilinear treatments demonstrate that islands smaller than the linear tearing layer are stabilized completely by the influence of the electron temperature gradient. A nonlinear theory is developed for larger islands. Standard algebraic growth is obtained unless diamagnetic effects are strong, in which case the time-asymptotic stability is dependent on the density and temperature profiles.

24269 **Resistive fluid turbulence in diverted tokamaks and the edge transport barrier in H-mode plasmas.** Hahm, T.S.; Diamond, P.H. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712-1060). *Physics of Fluids;* **30**: No. 1, 133-143(Jan 1987).

The thermal and particle diffusivities driven by resistive fluid turbulence in diverted tokamak edge plasmas are calculated. Diverted tokamak geometry is characterized by increased global shear near the separatrix and the tendency of field lines to linger near the x point. For resistive fluid turbulence, the dominant effect is increased global shear, which causes a reduction in the effective step size of the turbulent diffusion process and corresponding improvements in heat and particle confinement close to the separatrix. Stability of resistive kink modes resonant near separatrix is also ensured by the increased global shear. The relevance of these considerations to the L→H transition and to the edge transport barrier in H-mode plasmas is discussed.

24270 **Computational study of ion cyclotron frequency stabilization of the m = 1 interchange mode in mirror geometry.** Myra, J.R.; D'Ippolito, D.A.; Francis, G.L. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **30**: No. 1, 148-159(Jan 1987).

A cylindrical plasma model is used to study the stabilizing effect of electromagnetic ion cyclotron frequency range (ICRF) waves on the m = 1 magnetohydrodynamic interchange mode. The fast wave eigenmodes of the column and the near-field antenna pattern are calculated numerically for a diffuse plasma profile when ω>Ω/sub i/. The resulting ponderomotive force and sideband contributions to global interchange stability are then determined using a rigid shift trial function. For far-field stabilization it is verified that the direct ponderomotive and sideband contributions cancel exactly as the conducting wall supporting the fast wave eigenmode moves out to infinity. The near-field stabilization effect is related numerically to the driven k/sub parallel/ spectrum of the waves and their radial profiles. The numerical model is employed to calculate threshold ICRF wave amplitudes for the stabilization experiments in the Phaedrus tandem mirror [Phys. Rev. Lett. 51, 1955 (1983)].

24271 **Stimulated Raman scattering of nonlinear space-charge and transverse magnetic waves with a longitudinal wiggler.** Fenstermacher, D.L.; Seyler, C.E. (School of Electrical Engineering and Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Physics of Fluids;* **30**: No. 1, 190-199(Jan 1987).

A formulation is given for the parametric coupling of nonlinear space-charge waves with transverse magnetic (TM) waveguide modes through a longitudinal wiggler field. The model is based upon the simplifying assumption of thin electron beam geometry, which requires only one-dimensional dynamics of the space-charge waves, and is an exact formulation in the limit of infinitesimally thin beams. A reduced model, obtained through the application of standard time-averaging techniques, leads to an analytic expression for the parametric growth rate as a function of beam parameters, pump strength, and wave mismatch. A numerical code is developed and used to solve the unapproximated model equations, and comparisons are made with the analytic theory. Agreement is good in the domain of applicability of the theory. It is also found numerically that nonlinear steepening and associated slowing of the space-charge waves: aspects usually neglected in ponderomotive theories: have important consequences on the evolution of the instability in the strongly nonlinear regime.

24272 **Electrostatic Kelvin—Helmholtz instability produced by a localized electric field perpendicular to an external magnetic field.** Pritchett, P.L. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **30**: No. 1, 272-275(Jan 1987).

The evolution of a plasma with a localized electric field perpendicular to an external magnetic field is shown to be dominated by the Kelvin—Helmholtz instability. For small ion gyroradius, the instability is similar to the fluid mode. When the ion gyroradius is an appreciable fraction of the spatial extent of the electric field, the plasma is not in equilibrium, and the initial drift profile relaxes. Subsequent evolution still leads to vortex flows.

24273 **Kinetic full wave theory of strong spatial damping of electron cyclotron waves in nearly parallel stratified plasmas.** Fruchtman, A.; Riedel, K.; Weitzner, H.; Batchelor, D.B. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **30**: No. 1, 115-128(Jan 1987).

Propagation of extraordinary mode waves in nearly parallel stratified plasmas (magnetic beach geometry) is investigated. Since these waves are very heavily damped WKB theory is unreliable and kinetic effects make the problem inherently nonlocal. The reso-

nance region is treated by a boundary layer expansion which reduces the problem to an integrodifferential system in one dimension. It is proved analytically that for moderate to high density, waves incident from the high field side are totally absorbed with no reflected wave. At very low density some transmission is possible, where the transmission coefficients are being given correctly by cold plasma theory. Numerical solution of the integrodifferential system shows that the power deposition profile can differ significantly from that predicted from a local WKB theory.

24274 **Laser filamentation in a thermally unstable plasma.** Liang, E.P.; Langdon, A.B. (Physics Department, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **30**: No. 1, 175-178(Jan 1987). Contract W-7405-ENG-48.

The propagation of laser light in a thermally unstable plasma attributable to potential imbalances in the local heating and cooling rates caused by density or temperature perturbations is considered. The linear growth rates of laser filamentation and thermal instability are governed by a single fifth-order dispersion relation. The behavior of different modes in various limits is discussed in detail and examples of potential applications to laser—target interactions are given.

24275 **Model for thermal transport in tokamaks.** Guzdar, P.N.; Liu, C.S.; Dong, J.Q.; Lee, Y.C. (University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **57**: No. 22, 2818-2821(1 Dec 1986).

The cause for anomalous electron-energy confinement in tokamaks is an active area of research. In this Letter we present a model for the anomalous electron-energy transport and compare it with experimental results.

24276 **Nonlinear evolution of current-driven instabilities in a reversed-field pinch.** Carreras, B.A.; Holmes, J.A.; Diamond, P.H. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **53**: 242-243(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Plasmas can be confined in a toroidal configuration using magnetic fields generated by external coils and internal plasma currents. In a toroidal configuration, the magnetic field line equations constitute a Hamiltonian system which one and one-half degrees-of-freedom. This fact establishes a simple correspondence between a toroidal magnetic field and a nonlinear Hamiltonian system. This correspondence equates magnetic field lines in real space to orbits of the Hamiltonian system in phase space, and the magnetic field-line arc length to time. For the plasma to be well confined, the magnetic field lines should form nested flux surfaces, corresponding to constant energy surfaces for the Hamiltonian system. For a magnetic system invariant under a uniparametric group of transformations, such as rotations around the axis of the torus, nested flux surfaces exist. That is, the Hamiltonian is integrable. However, in a more general case without symmetry, the existence of flux surfaces is not assured. In practice, the symmetry of a magnetic configuration may be broken by the intrinsic character of the configuration (no symmetry in the coil system) or by the traces generated for n(t) were Fast-Fourier transformed to obtain power spectral densities (PSDs).

24277 **Cavity mode analysis of plasma frequency waves in inhomogeneous cylindrical plasmas.** Hutchinson, I.H.; Gandy, R.F. (Massachusetts Institute of Technology, Cambridge). *Physics of Fluids;* **28**: No. 4, 1090-1096(Apr 1985). Contract AC02-78ET51013.

A linear, electromagnetic analysis is presented of the cavity mode structure and dispersion relations for waves with frequency near the electron-plasma frequency in cylindrical plasmas with monotonically decreasing electron density and finite magnetic field. Analytic solutions are obtained which are exact in the limits when either the ratio of electron cyclotron to plasma frequency or the ratio of plasma size to parallel wavelength tends to infinity. Comparison with numerical solutions confirms that the analytic results are highly accurate even for fairly modest values of these ratios. Thermal effects are incorporated, including Landau (damping or) gain, which show the lowest-order transverse modes to have greatest gain. These modes are highly localized near the cylinder axis so that the plasma itself acts as a cavity, regardless of edge boundary conditions. The theory thus enables an interpretation to be made of maser action in quasicylindrical plasmas such as tokamaks. 11 references, 4 figures.

24278 **Plasma physics via computer simulation.** Birdsall, C.K.; Langdon, A.B. New York, NY; Mc Graw-Hill Book Co. (1985). 512p. Mc Graw-Hill Book Co., 1221 Avenue of the Americas, New York, NY 10020.

This book describes the computerized simulation of plasma kinetics. Topics considered include why attempting to do plasma physics via computer simulation using particles makes good physical sense; overall view of a one-dimensional electrostatic program; a one-dimensional electrostatic program; introduction to the numerical methods used; a 1d electromagnetic program; projects for EM1; effects of the spatial grid; effects of the finite time step; energy-conserving simulation models; multipole models; kinetic theory for fluctuations and noise; collisions; statistical mechanics of a sheet plasma; electrostatic programs in two and three dimensions; electromagnetic programs in 2D and 3D; design of computer experiments; and the choice of parameters.

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REFER ALSO TO CITATION(S) 22864, 22877, 23201, 23214, 23216

24279 **(ANL/FPP/TM—212) Self-pumping inpurity control systems for INTOR.** Brooks, J.N.; Mattas, R.F.; Smith, D.L.; Hassanein, A.M. (Argonne National Lab., IL (USA)). Jan 1987. Contract W-31109-ENG-38. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007530.

Two self-pumping systems have been examined for use as the INTOR impurity control system. The systems work by trapping helium in freshly deposited metal surface layers on or near the divertor plate. A slot divertor concept using vanadium or other trapping material appears to be both feasible and mechanically simple, and offers significant advantages in cost, reduced complexity, and helium pumping efficiency for the INTOR design.

24280 **(CONF-870405—4) One- and two-dimensional radiation analysis of the Compact Ignition Tokamak.** Selcow, E.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004626.

From Radiation protection and shielding conference; Knoxville, TN, USA (22 Apr 1987).

The Compact Ignition Tokamak (CIT) is being proposed as the next major fusion experiment to follow the operations of the Tokamak Fusion Test Reactor (TFTR). CIT is a compact deuterium-tritium-burning tokamak device that is designed to achieve ignition. The high neutron wall loadings, 7 to 9 MW/m^2, associated with the operation of this device require that neutronics-related issues be considered in the overall system design. Radiation shielding is required for the protection of both device components and personnel. A close-in igloo shield, 1.8 m nominal thickness, has been designed around the periphery of the tokamak structure to permit personnel access into the test cell after shutdown and to limit the total activation of the test cell components. This paper discusses the major neutronics issues related to the design of the Compact Ignition Experiment, describes the methodologies used to quantify these concerns, and presents the results of radiation transport and activation scoping studies.

24281 **(DOE/ER/13064—4) Analysis of impact fusion target dynamics: Final report, April 15, 1983 through August 15, 1986.** Ribe, F.L.; Christiansen, W.H.; MacCormack, R.W. (Washington Univ., Seattle (USA). Aerospace and Energetics Research Program). 1 Mar 1987. Contract AT06-83ER13064. 61p. (UWAERP—11). NTIS, PC A04. File Number DE87006728.

One- and two-dimensional calculations of the hydrodynamics of impact fusion were investigated. Calculations for D-T pellets in

the reactor regime are given. Appendices cover the following areas: (1) numerical studies of impact-fusion target dynamics, (2) computation equation-of-state and opacity packages, (3) modeling of the equation of state for hydrogen and solid materials, and (4) numerical solution of the two-dimensional Euler equations. (MOW)

24282 **(DOE/ER/13064—5) Numerical studies of impact-fusion target dynamics.** Ribe, F.L.; Christiansen, W.H.; MacCormack, R.W.; Sankaran, L.; Yaghmaee, S. (Washington Univ., Seattle (USA). Aerospace and Energetics Research Program). 1986. Contract AT06-83ER13064. 51p. (CONF-8607118—1). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006286.

From 4. ICENES conference; Madrid, Spain (7 Jul 1986).

Impact fusion involves the collision of gas-filled metallic shells which heat the gas to fusion conditions. We report on the numerical solution of the one-dimensional (1-D) and two-dimensional (2-D) Euler equations for the combination of metallic shells and internal deuterium gas with a typical initial radial velocity of 25 km/s, corresponding to possible next generation rail-gun velocities. In the 2-D case impacting shells whose initial shapes are spherical caps making acute internal angles of contact produce a quasispherical compression of the internal gas, initially assumed to be at rest. The computations proceed through turnaround, corresponding to maximum plasma compression, neutron yield and quasispherical cavity shaping. We compare plasma parameters and energy efficiency with the 1-D, spherical case.

24283 **(DOE/ER/53198—104) Reversed field pinch boundary study: Annual progress report for the period March 14, 1986-March 13, 1987.** Dexter, R.N.; Prager, S.C.; Sprott, J.C. (Wisconsin Univ., Madison (USA)). 1987. Contract FG02-85ER53198. 47p. NTIS MF A01; 2; GPO Dep. File Number DE87006815.

This report summarizes our present status and progress during the second year of support of our program to investigate the RFP boundary. It is a year in which we formed and studied a sustained RFP, demonstrated that the RFP state survived the insertion of a toroidal rail limiter at least 20% of the minor radius of the plasma, and investigated curvature-related fluctuations as a function of safety factor from tokamak into the RFP state. We demonstrated self-reversal at startup voltages of about 200 volts, no liner being present to protect the poloidal gap. These key steps towards MST, the Madison Symmetric Torus, now approaching completion as a vacuum tank in Italy, were carried to a secure point, then terminated in favor of the scheduled installation of four rings to form a magnetic divertor RFP configuration. This upgrade was smoothly accomplished, but unlike the case without rings, we have been unable to form a sustained RFP so far, by self-reversal or with aided reversal. We have not shown that replacing the conducting shell with a conducting separatrix is a possible configuration for a sustained RFP, but neither have we found any evidence that it is impossible. We simply have not been able to apply the poloidal gap voltage levels required.

24284 (EUR—9708-Vol.2, pp 339-358) **Stellarator magnetic surfaces without islands.** Cary, J. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

Methods for finding stellarator magnetic fields with good flux surfaces, no islands and no stochasticity are considered. First, a method for finding optimal coil winding laws is presented. This method yields magnetic fields without islands or stochasticity. These fields have rotational transform near the theoretical limit m/l and an increased value of <+2>epsilon, a figure of merit related to maximum confinable plasma pressure. This leads to a discussion of how plasma modifies these fields. An asymptotic, low pressure analysis shows that, typically, plasma does not drive significant islands, if the vacuum magnetic field has good average curvature. However, if it has bad average curvature, island overlap is present at arbitrarily small but nonzero plasma pressure.

24285 (EUR—9708-Vol.2, pp 681-700) **High average power and high peak power gyrotrons: present capabilities and future prospects.** Granatstein, V.L. (Ecole Polytechnique Federale, Lausanne, Switzerland; Commission of the European Communities, Brussels, Belgium. Fusion programme). 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE87751132. (CONF-840616—Vol.2).

From Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities; Lausanne, Switzerland (27 Jun 1984).

High average power gyrotrons (1 MW at 100-150 GHz) are required for ECRH of magnetic fusion plasmas. Even though gyrotrons have superior mode stability compared with other tubes, they must be so grossly overmoded to handle 1 MW CW that mode control does become an issue. Studies of gyrotron-oscillator cavity designs with enhanced mode stability properties are described, including complex cavities and Fabry-Perot cavities. In the complex cavity concept, two cavities each operating in a different mode are strongly coupled. Designs of TE_{03}/TE_{04} and TE_{03}/TE_{06} gyrotrons which promise to extend performance are discussed. A 115 GHz gyrotron using a Fabry-Perot cavity has been successfully demonstrated at power levels above 50 kW and prospects of extending performance are considered. Study of high peak power gyrotrons is stimulated by the perceived requirement for 300 MW rf sources at lambda approximately 3 cm to drive very high energy (1 TeV) linear electron accelerators. For this application, the phase of the microwave signal must be precisely controllable. These demanding requirements have led to renewed interest in gyroklystron amplifiers, and studies of relatively low power gyroklystrons will be reviewed. Finally, a design of a 300 MW gyroklystron is presented.

24286 (EUR-CEA-FC—1295, pp 37-40) **Modular multijunction grill for current drive studies at 3.7 GHz for Petula-B and TORE SUPRA.** Rey, G.; Berger-By, G.; Bibet, P. (Association EURATOM-C.E.A CEN Grenoble, 38, France. Dept de Recherches sur la Fusion Controlee). May 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87751062. (CONF-860412—).

From 13. European conference on controlled fusion and plasma heating; Schliersee, F.R. Germany (14 Apr 1986).

A 8 MW - quasi continuous - 3.7 GHz Lower Hybrid Heating system is being designed for mainly current-drive studies on the TORE SUPRA Tokamak. A large simplification of the L.H. antenna and of the RF transmission line is obtained by applying two main ideas: (i) modular design, (ii) internal RF power division - 3 dB hybrid junction and E-plane multijunction. The E-plane M.J. system brings not only simplification in the building of the antenna, but also, when used in travelling wave, lowers strongly the power reflection coefficient towards the generator. This is a very important point, because such a system allows to avoid the use of circulators - expensive elements for large machine.

24287 (IA—1421, pp 34-35) **Minimum thickness lithium-lead blankets.** Kinrot, A.; Greenspan, E. Jun 1986. NTIS (US Sales Only), PC A12/MF A01. File Number DE87780103.

Published in summary form only.

In Research laboratories annual report 1985.

24288 **(INIS-mf—10522) Design and construction of electronic components for a "Novillo" Tokamak.** Lopez C, R. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria Mecanica y Electrica). Jul 1986. 136p. (In Spanish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87701567.

The goal of this effort was to design, construct and make functional the electronic components for a "Novillo" Tokamak currently being experimentally investigated at the National Institute of Nuclear Research in Mexico. The problem was to develop programmable electronic switches capable of discharging high voltage kilowatt energies stored in capacitator banks onto the coils of the Tokamak.

24289 (INIS-SU—401, pp 37-40) **Study on the dynamics of cryolayer behaviour in targets with the presence of temperature gradient.** Koresheva, E.P.; Nikitenko, A.N. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780111.

Kratkie Soobshcheniya po Fizike.; No. 1.

In Experimental and theoretical physics. Collection.

Experimental investigation of the cryolayer dynamics in the taget in the presence of temperature gradient is carried out in order to optimize the process of cryogenic target compression in the laser fusion chamber. Experimental measurements of the temperature dependence of substance transfer time in one part of the sphere have shown the sharp increase of localization time for the layer of n-H/sub 2/ at T < 10 K. This effect has been observed for n-D/sub 2/ layer at T < 12 K. It is shown that the presence of temperature gradient on the target surface is the reason of the formation of different thickness of cryolayer. Conditions for conservation of equal thickness cryolayer are determined.

24290 (JAERI-M—86-061) **Analysis of multislot directional coupler.** Arai, Hiroyuki; Goto, Naohisa; Yamamoto, Takumi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87701587.

This paper presents an analysis of multislot directional coupler for monitoring the gyrotron output. We solved the boundary value problem of the directional coupler to investigate the detailed effect of finite thickness slot and mutual coupling between slots. Numerical data of coupler design is presented for non-resonant a pair slot, and mode sensitivity in overmoded waveguide is also evaluated.

24291 (JAERI-M—86-064) **Conceptual design of negative-ion based 500 keV 20 MW neutral beam injector.** Horiike, Hiroshi; Ohara, Yoshihiro; Okumura, Yoshikazu; Shibata, Takemasa; Tanaka, Sigeru. (Japan Atomic Energy Research Inst., Tokyo). Apr 1986. 153p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87701588.

The conceptual design of 500 keV, 20 MW neutral beam injector is reported in the present document. This design utilizes a negative ion source to realize a efficient high power neutral beam injector, by taking advantage of the high neutralization efficiency of negative ions at high energy. In the present report, the conceptual design of the source plasma generator and the accelerating system is presented first. Three candidate systems are then examined, each with a different neutralizing cell. The system having a very long neutralizer was judged to be the most suitable to the reactor considered. It was designed in detail. The long neutralizer (30 m) has many advantages: 1) The ion source can be located far from the reactor, permitting a narrow injection tube and tangential injection angle; 2) Neutron shielding is easy because the solid angle of the beam line is very small; 3) Complex components are removed from the vicinity of the reactor. The simplicity of the beam line leads us to believe that the chances for its actualization as a reactor injector is very high. More efficient neutralizers, such as a plasma neutralizer or a laser cavity, will give more flexibility to this design and provide further advantages for this injector. The realization of this injector will require development work for the negative ion source, the high voltage power supply, and the ion dump. When these components are developed, the rest of the system will be designed using previously developed positive-ion-beam technology. The present report is based upon notes from design meetings and broadly summarizes discussions, estimations and data those determined the parameters.

24292 (JINR—E-4-85-953) **Cross sections for scattering of deuterium misic atoms on deuterium nuclei.** Melezhik, V.S.; Wozniak, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87701402.

Submitted to the journal Phys. Lett., A.

Cross sections have been calculated for elastic scattering of deuterium mesic atoms in ortho and para states on deuterium nuclei in the 0-50 eV energy range; cross sections for spin-flip have also been calculated. The calculation have been performed in the adiabatic representation where the initial problem of slow collisions in a three-body system is reduced to the multichannel scattering problem. The temperature dependence of the ortho-para transition rate Λsub(hf)(T) for dμ-atoms is obtained for a deuterium target. The calculated rate Λsub(hf)(34K)=(37.2 x 10sup(6) s/sup -1/ (Vienna-SIN group, 1983). 11 refs.; 6 figs.; 1 tab.

24293 (Juel—2041) **Determination of the entrance rate and release rate constants and of the diffusion rate constants of hydrogen and deuterium for Inconel 600, by means of permeation measurements and the observation of recycling in the tokamak TEXTOR.** Rota, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Duesseldorf Univ. (Germany, F.R.)). Feb 1986. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87751198.

The aim of the work was the determination of material constants for Inconel 600, which characterize the recycling processes between gaseous hydrogen and metallic walls. The study of such processes is particularly important for the present-day tokamaks and for future fusion devices, because the hydrogen coming from the plasma during a discharge reaches the inner wall, and is reemitted from it several times. The main part of the experiments was the observation of the stationary and time-dependent hydrogen (H/sub 2/ and D/sub 2/) permeation flux through a membrane of Inconel 600. A further part of the experiments was the observation of hydrogen release at the upstream side of the membrane, when this side of the membrane is exposed to atomic hydrogen. This allows us to determine the 'recycling constant' R/sub c/=D/2σk/sub r/. The method is very suitable for a tokamak device and was applied for the first time in the tokamak TEXTOR.

24294 (Juel—2056) **Thermal shock testing of ceramics with pulsed laser irradiation.** Benz, R.; Naoumidis, A.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe). Apr 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751345.

Arguments are presented showing that the resistance to thermal stressing ("thermal shock") under pulsed thermal energy deposition by various kinds of beam irradiations is approximately proportional to PHI/sub a/√tp, where PHI/sub a/ is the absorbed power density and tp is the pulse length, under conditions of diffusivity controlled spreading of heat. In practical beam irradiation testing, incident power density, PHI, is reported. To evaluate the usefulness of PHI√tp as an approximation to PHI/sub a/√tp, damage threshold values are reviewed for different kinds of beams (electron, proton, and laser) for a range of tp values 5x10/sup -6/ to 2 s. Ruby laser beam irradiation tests were made on the following ceramics: AlN, BN, graphite, αSiC, β-SiC coated graphites, (α+β)Si/sub 3/N/sub 4/, CVD (chemical vapor deposition) TiC coated graphite, CVD TiC coated Mo, and CVD TiN coated IN 625. The identified failure mechanisms are: 1. plastic flow followed by tensile and bend fracturing, 2. chemical decomposition, 3. melting, and 4. loss by thermal spallation. In view of the theoretical approximations and the neglect of reflection losses there is reasonable accord between the damage threshold PHI√tp values from the laser, electron, and proton beam tests. (orig./IHOE).

24295 (KFK—4097) **Data acquisition and processing for testing of superconducting coils.** Donner, I.; Froehlich, D.; Heep, W.; Padligur, U.; Rietzschel, K.; Wuerz, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Datenverarbeitung und Instrumentierung). Jun 1986. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751346.

This document will describe the use of a computer controlled data acquisition system in performing measurements at the coil test facility TOSKA (Toroidale Spulentesteinrichtung Karlsruhe). The design and logic of special CAMAC data acquisition modules and questions of measuring techniques are discussed. Also the functional characteristics of special software developments like the program system for realtime processing of measuring data and the program package for graphics display of stored data are described.

24296 **(KFK—4168) Polarization of solid deuterium-tritium fuel for nuclear fusion.** Heeringa, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87751237.

The advantages of using polarized DT-fuel are discussed. An outline is given of the standard methods employed to produce polarized solid hydrogen targets for nuclear physics. The applicability of these methods for obtaining polarized DT is analysed. Large polarizations seem to be realisable in spite of the tritium decay heat, which hinders the attainment of low temperatures.

24297 (LRP—252/84, pp C.1-C.7) **Discontinuous heating behaviour observed in the TCA tokamak and its interpretation in terms of the Alfven wave spectrum.** Appert, K.; de Chambrier, A.; Collins, G.A.; Duperrex, P.A.; Heym, A.; Hofmann, F.; Hollenstein, C.; Joye, B.; Keller, R.; Lietti, A. (Ecole Polytechnique Federale de Lausanne, Switzerland; Univ. of Fribourg, Switzerland). Oct 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900202. (CONF-840311—Exc.).

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Since Alfven wave heating relies on the absorption of a wave's energy at resonance surfaces within the plasma, there should be some correlation between the observed heating and the position of these surfaces. The early heating experiments on TCA, while showing significant electron and ion temperature increases, failed to show such a correlation. Improvements to the experiment, particularly due to active current control and attempts to find the best limiter material and design, allowed confirmation of both the electron and the ion heating and increased the maximum rf power that could be delivered. Detailed experiments and analyses have been performed to determine which antenna structures can excite the mode and to quantify the effects of heating both with and without the mode in the plasma. A modified version of the ERATO stability code was used to give a two dimensional model of the excitation process, with the restriction of ideal MHD that ω/ω/sub ci/ = 0. We have been able to confirm our earlier identification of the new mode, and to show that it is due to toroidal coupling of different poloidal modes in the plasma.

24298 (LRP—252/84, pp J.1-J.6) **Alfven wave heating results in TCA using coated bar antennae.** de Chambrier, A.; Collins, G.A.; Duperrex, P.A.; Heym, A.; Hofmann, F.; Hollenstein, C.; Joye, B.; Keller, R.; Lietti, A.; Lister, J.B. (Ecole Polytechnique Federale de Lausanne, Switzerland; Univ. of Fribourg, Switzerland). Oct 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900202. (CONF-840311—Exc.).

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

The Alfven Wave launching antennae in TCA have been changed. The wide stainless steel plates previously used have been replaced by a simple bar-antenna structure which has nonetheless maintained a pure n-spectrum. The antennae have also been coated with titanium nitride. We present results on the coupling properties of the new antennae and their effects on the plasma. Preliminary indications are that there is a considerable reduction in the metallic impurity concentration following this change.

24299 (LRP—252/84, pp P.1-P.7) **Non-linear antenna loading measurements in TCA.** de Chambrier, A.; Collins, G.A.; Duperrex, P.A.; Grossmann, M.; Heym, A.; Hofmann, F.; Hollenstein, C.; Joye, B.; Keller, R.; Lietti, A. (Ecole Polytechnique Federale de Lausanne, Switzerland; Univ. of Fribourg, Switzerland; JET-Joint Undertaking, Abingdon, England). Oct 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900202. (CONF-840311—Exc.).

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

The TCA tokamak is mainly dedicated to the study of additional heating by the absorption of Alfven Waves (ω << ω/sub ci/). Rf waves are launched by the antennae to heat the plasma core. Unwanted edge dissipation can reduce the heating efficiency and may lead to spurious edge heating. A sufficiently large bias voltage of the antennae can decrease the rf impedance, as well as increase the strength of the wavefields. This observation indicates the presence of some parasitic loading, particularly evident at low power, and reduced above 50 kW. The loading stabilizes at bias voltages below -60 volts. The asymptotic loading is compared with numerically calculated values. The origin of these effects is discussed.

24300 **(SAND—87-0635C) Progress on the Particle Beam Fusion Accelerator II for light ion fusion.** VanDevender, J.P.; Wright, T.P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870302—8). NTIS MF A01; 2; GPO Dep. File Number DE87006893.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Particle Beam Fusion Accelerator II (PBFA II) at Sandia National Laboratories is the largest in the series of particle beam drivers and the first with the potential of achieving the necessary energy and power density required for igniting thermonuclear fuel in the laboratory. PBFA II is a series of experiments in pulsed power, power flow, ion sources, lithium ion beam generation, beam transport, beam focussing, radiation physics and implosion hydrodynamics. If these challenging experiments are successfully completed, then thermonuclear fuel may be ignited in the laboratory for the first time. Because of the large number of research items in series, the risk is very high and the experiments will require many years of intensive effort. On December 15, 1985, PBFA II construction was completed and the accelerator was activated. Since that time, the pulsed power has been developed and major experiments in power flow and ion sources have been conducted. Preliminary experiments on beam generation have also been conducted. The accelerator is currently operating and providing one fully diagnosed experiment each week. The PBFA II program and the results to date with this technology will be presented.

24301 **(UCID—20773-Vol.2) MINIMARS conceptual design: Final report.** Lee, J.D. (ed.). (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA); General Dynamics Corp., San Diego, CA (USA). Space Systems Div.; Grumman Aerospace Corp., Bethpage, NY (USA); Canadian Fusion Fuels Technology Project, Toronto, Ontario). Sep 1986. Contract W-7405-ENG-48. 510p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE87006585.

This volume contains the following sections: (1) fueling systems; (2) blanket; (3) alternative blanket concepts; (4) halo scraper/direct converter system study and final conceptual design; (5) heat-transport and power-conversion systems; (6) tritium systems; (7) minimars air detritiation system; (8) appropriate radiological safety design criteria; and (9) cost estimate. (MOW)

24302 **Fabrication of high-gain inertial fusion targets using gas jet cooling and intensity-graded laser illumination.** Kim, K.; Krahn, D.L. (Fusion Technology/Charged Particle Research Laboratory, University of Illinois, 1406 W. Green Steet, Urbana, Illinois 61801). *Journal of Applied Physics;* **61**: No. 8, 2729-2733(15 Apr 1987).

A new method, which is particularly suitable for fabricating a uniformly thick solid- or liquid-fuel layer inside an inertial confinement fusion target, is described. The method employs a cold helium-gas-jet shower to uniformly cool a target and an intensity-graded laser illumination to create a desired thermal gradient across the target. The net result is a thermally induced fuel migration inside the target, which precisely counterbalances the gravity-induced fuel sagging, bringing about a uniform layer of fuel condensate on the target interior. This new method is significant for the following reasons: First, it allows for fabrication of both solid- and liquid-fuel layers. Second, it is a noncontact method. Third, it requires either none or very little cryogenic shielding. Fourth, it is simple to implement. Fifth, it allows for easy diagnostic access to the target. Details of the apparatus and results showing the capabilities of the method are presented.

24303 **Production of spin polarized fusion fuels.** Honig, A. (to Syracuse Univ., Syracuse, NY). US Patent 4,642,206. 10 Feb 1987. Filed date 27 Jun 1983. vp.

The method is described of producing polarized deuterons in solid HD that includes the steps of providing a sample of HD containing a 10/sup -4/ to 10/sup -3/ concentration (mole fraction) of rho-D/sub 2/, irradiating the sample with radiation that produces defect centers in the sample for increasing the conversion rate of rho-D/sub 2/ to o-D/sub 2/, subjecting the sample simultaneously to a magnetic field greater than 10 Telsa and a temperature less than 10 m°K. such that the H/sub O//T ratio is in a range of between 1000 and 7500 T/°K. corresponding to a deuteron polarization range of 20% to 90%, and allowing rho-D/sub 2/ to convert to o-D/sub 2/ to increase the relaxation time of the polarized deuterons at ordinary liquid helium temperatures of 1°-4°K. and low magnetic fields of about 0.1 Telsa. The method is also described of producing polarized tritons in solid HT that includes the steps of epitaxially depositing alternate layers of HT having a thickness of about 1 μm on thicker layers of solid HD at temperatures 0.3 to 4°K. wherein the protons in the HD are polarized and the deuterons are either polarized or unpolarized, allowing the proton polarization in the HD layer to diffuse to polarize the protons in the HT layers through spin diffusion, placing the layers in a radio frequency field, and radiating the layers with radio frequencies to induce partially forbidden transitions between the polarized proton and the unpolarized triton coupled energy levels to polarize the tritons directly.

24304 **Evaluation of charcoal sorbents for helium cryopumping in fusion reactors.** Tobin, A.G.; Sedgley, D.W.; Batzer, T.H.; Call, W.R. (Grumman Corporation, Bethpage, New York 11714). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 1, 101-105(Jan 1987).

Improved methods for cryopumping helium were developed for application to fusion reactors where high helium generation rates are expected. In this study, small coconut charcoal granules were utilized as the sorbent, and braze alloys and low temperature curing cements were used as the bonding agents for attachment to a copper support structure. Problems of scale-up of the bonding agent to a 40 cm diam panel were also investigated. Our results indicate that acceptable helium pumping performance of braze bonded and cement bonded charcoals can be achieved over the range of operating conditions expected in fusion reactors.

24305 **CODAS: The JET control and data acquisition system.** Van der Beken, H.; Best, C.H.; Fullard, K.; Herzog, R.F.; Jones, E.M.; Stead, C.A. (JET Joint Undertaking, Abingdon, Oxfordshire OX14 3EA). *Fusion Technology;* **11**: No. 1, 120-140(Jan 1987).

The hardware and software structure of the control and data acquisition system (CODAS) of the Joint European Torus is described. CODAS is a large distributed real-time process control system. The operation is centralized in two adjacent control rooms through a fully programmable man-machine interface. The plant interface is based on CAMAC instrumentation and Eurocard signal conditioning. The system is based on a network of minicomputers with a link to a host mainframe.

24306 **Neutron dosimetry qualification experiments for the Tokamak Fusion Test Reactor Lithium Blanket Module program.** Tsang, F.Y.; Harker, Y.D.; Anderi, R.A.; Nigg, D.W.; Jassby, D.L. (EG&G Idaho, Inc., Idaho National Engineering Lab., Fusion Technology Program, P.O. Box 1625, Idaho Falls, ID 83415). *Fusion Technology;* **10**: No. 3, 396-404(Nov 1986).

The Tokamak Fusion Test Reactor (TFTR) Lithium Blanket module (LBM) program is a first-of-kind neutronics experiment involving a toroidal fusion neutron source. Qualification experiments have been conducted to develop primary measurement techniques and verify dosimetry materials that will be used to characterize the neutron environment inside and on the surfaces of the LBM. The deuterium-tritium simulation experiments utilizing a 14-MeV neutron generator and a fusion blanket mockup facility at the Idaho National Engineering Laboratory are described. Results and discussions are presented that identify the quality and limitations of the measured integral reaction data, including the minimum fluence requirement for the TFTR experiment and the use of such data in neutron spectrum adjustment and in predicting integral performance parameters, e.g., tritium production.

99 GENERAL AND MISCELLANEOUS

24307 **(CONF-870212—1) The labor market for mining engineers: Recent experience and outlook for the future.** Finn, M.G.; Johnson, D.L. (Oak Ridge Associated Universities, Inc., TN (USA)). 1987. Contract AC05-76OR00033. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006363.

From Annual meeting and exhibition of the Society of Mining Engineers; Denver, CO, USA (24 Feb 1987).

This survey indicates that, although the market for mining engineers has weakened in recent years, the worst of the projected declines in mining engineering employment may already have taken place. (DLC)

24308 **(DOE/MA—0287) Listing of awardee names: Active awards as of January 29, 1987.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Procurement and Assistance Management Directorate). 29 Jan 1987. 532p. NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE87005445.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Active is defined as the completion date of the award is later (in the future) than the date of the issuance of the listing.

24309 **(DOE/OR/00033—T289) US Department of Energy High School Student Supercomputing Honors Program: A follow-up assessment.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 43p. NTIS MF A01; 2; GPO Dep. File Number DE87007058.

The US DOE High School Student Supercomputing Honors Program was designed to recognize high school students with superior skills in mathematics and computer science and to provide them with formal training and experience with advanced computer equipment. This document reports on the participants who attended the first such program, which was held at the National Magnetic Fusion Energy Computer Center at the Lawrence Livermore National Laboratory (LLNL) during August 1985.

24310 **(DOE/OR/00033—T290) US Department of Energy University Research Instrumentation Program, FY1984: A follow-up report.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 23p. NTIS MF A01; 2; GPO Dep. File Number DE87007340.

The US Department of Energy (DOE) initiated its University Research Instrumentation (URI) Program in FY1984 as part of an interagency effort coordinated by the Office of Science and Technology Policy. Objective is to help upgrade the capability of universities to conduct advanced research and to support the training of graduate students in science and engineering. This document reports on the use of URI equipment approximately one year after its funding in FY1984.

24311 **(DOE/OR/00033—T291) Historically Black Colleges and Universities Fossil Energy Faculty Research Training Program: FY1986 annual report.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007339.

Purpose of the Historically Black Colleges and Universities (HBCU) Fossil Energy Faculty Research Training Program is to increase the involvement of faculty members from HBCUs as collaborators in relevant fossil energy research and development supportive of the Pittsburgh Energy Technology Center (PETC).

24312 (DOE/OR/00033—T292) Office of Health and Environmental Research Historically Black Colleges and Universities Faculty and Student Research Participation and Training Program: FY1986. (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1987. Contract AC05-76OR00033. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007338.

Purpose of the Office of Health and Environmental Research (OHER) Historically Black Colleges and Universities (HBCUs) Faculty and Student Research Participation and Training Program is to provide training and collaborative research participation opportunities in OHER-supported programs and activities at designated US Department of Energy (DOE) research and development facilities. The program advances the mission of OHER, strengthens the research and teaching capabilities of HBCUs in disciplines supportive of OHER program activities, and introduces faculty members and students to DOE facilities and the OHER mission.

24313 (GKSS—86/E/1) Scientific technical reports of the GKSS 1985. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87751342.

The survey gives the names of authors and the titles of all external GKSS reports published in 1985, of which - with the exception of reprints in journals - abstracts and/or bibliographic data are given.

24314 (RISO-M—2557) Health Physics Department annual progress report 1 January-31 December 1985. (Risoe National Lab., Roskilde (Denmark)). Oct 1986. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750888.

The report describes the work of the Health Physics Department at Risoe during 1985. The activities cover dosimetry, instrumentation, radioecology, risk by nuclear activities and nuclear emergency preparedness. Lists of staff and publications are included. The main emphasis in the report has been placed on scientific and contractual work. Of lesser importance, but still quite significant, are the service functions.

24315 (UCID—20622-87-1) Chemistry and Materials Science: Quarterly research report: Weapons supporting research, departmental institutional research and development, September-December 1986. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87007446.

Summaries are given of research conducted in advanced materials, materials characterization and analysis, physical metallurgy, chemical reactions and transport processes, and properties of hydrogen isotopes. (DLC)

24316 (UCRL—95891) Organizing for quality: A structural perspective. Dronkers, J.J. (Lawrence Livermore National Lab., CA (USA)). 7 Jan 1987. Contract W-7405-ENG-48. 23p. (CONF-870544—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87004356.

From 41. annual quality conference; Minneapolis, MN, USA (4 May 1987).

This paper discusses an aspect of QA program implementation that often has been overlooked: existing organizational structures. The paper's premise is that existing organizational structures have a great deal to do with an organization's culture and therefore must be considered when implementing QA programs. The paper reviews major quality assurance programs descriptions as are found in several standards and in the writings of Crosby, Feigenbaum, and Juran. The review shows that quality assurance programs are concerned with both quality achievement and demonstrability of that achievement. Next, a review of organizational structures is considered. Two traditional ones: hierarchical and matrix structures, and an emerging one, parallel structure. Characteristic traits of each and their importance are discussed. The paper concludes with suggesting a method for implementing QA programs to existing structures. The method contemplated places the QA professional in the role of change agent. The method's basis is a critical review of what is needed in a QA program, and what already exists in the structure.

24317 (UCRL—96258) Toward the year 2000: The near future of the American civilian and military space programs. Wood, L.L.; Ishikawa, M.Y. (Lawrence Livermore National Lab., CA (USA)). Jan 1987. Contract W-7405-ENG-48. 10p. (CONF-870162—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006467.

From 3. national space symposium of the United States Space Foundation; Colorado Springs, CO, USA (20 Jan 1987).

The basic features of the American civilian and military space programs at the end of this century are identified and their histories traced back to the present time, for the "surprise-free" scenario. Several of the more likely surprises are noted, and their probable impacts sketched.

9901 Management

24318 (ANL/TM—432-Rev.1) ANL statement of site strategy for automated office support systems. Boxberger, L.M. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006874.

The "Statement of Site Strategy" consists primarily of eighteen chapters that together explain the overall Argonne strategy for defining, acquiring, using, and evaluating computing workstations and other automated office support systems. The five appendices clarify Argonne's responsibilities in managing microprocessors and word processors and in acquiring computing workstation components. Appendix E contains the justification form necessary for acquiring computing workstation equipment, software, or peripherals. 11 refs.

24319 (DOE/MA—0295) Work breakdown structure guide. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). 6 Feb 1987. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87007606.

Utilization of the work breakdown structure (WBS) technique is an effective aid in managing Department of Energy (DOE) programs and projects. The technique provides a framework for project management by focusing on the products that are being developed or constructed to solve technical problems. It assists both DOE and contractors in fulfilling their management responsibilities. This document provides guidance for use of the WBS technique for product oriented work identification and definition. It is one in a series of policy and guidance documents supporting DOE's project manaagement system.

24320 (IAN-AIM—4) Quality assurance in nuclear installations. Torres M, N. (Instituto de Asuntos Nucleares, Bogota (Colombia). Area de Aplicaciones Industriales y Metalurgia). Aug 1985. 38p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87701517.

It has been proven that the bad quality of products, equipment, installations, and services is not due to the lack of tests, experiments and verifications. The main causes are associated with insufficient organization of the activities that have influence on the quality. The garantee of quality is conceptualized as an appropriate instrument composed of normalized criteria initially in advanced technologies. Such as nuclear science and aerospace technology. However, with the appropriate modifications it can be applied to conventional technologies.

24321 (INIS-mf—10520) Memoir 1985. Instituto Nacional de Investigaciones Nucleares. (Instituto Nacional de Investigaciones Nucleares, Mexico City). 1985. 24p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701565.

A brief review of the National Institute of Nuclear Research is given and its activities in 1985 summarized, among which were the Institute's fabrication of nuclear fuel rods, advisory and techni-

cal support of the national nucleoelectric program, encouragement of the utilization of nuclear techniques in farming, livestock breeding, industry and health, improving processes in radioisotope production, construction of a metrology building for ionizing radiation measurement, training of manpower for the nucleoelectric industry, for applying nuclear techniques, and the assemblying of a pelletron electron accelerator. (m.r.).

24322 **(INIS-mf—10586) Progress report October 1985-September 1986 of the Institute for Theoretical Physics, University of Graz, Austria.** Lang, C.B. (comp.). (Graz Univ. (Austria). Inst. fuer Theoretische Physik). Dec 1986. 19p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87701574.

There is a listing of projects in the fields: 1) electromagnetic processes, 2) quantum mechanics and field theory, 3) elementary particle physics, 4) mathematical physics, 5) many-particle physics and nuclear physics, 6) semiconductor physics, 7) energy and fundamentals of nuclear energetics and a publication list. (G.Q.).

24323 **(UCRL—15868) FRM: An intelligent assistant for Financial Resource Management: [Final report, December 1984 through October 1986].** Buchanan, B.G.; Rindfleisch, T.C.; Cornelius, C.W. (Stanford Univ., CA (USA). Knowledge Systems Lab.; Lawrence Livermore National Lab., CA (USA)). 14 Nov 1986. Contract W-7405-ENG-48. 20p. NTIS, PC A02. File Number DE87007059.

FRM offers an easily understood and uniform user interface, a constraint management system for budget preparation, and a preliminary database system interface. Although the system's data and knowledge bases have developed around the Knowledge Systems Laboratory's organizational and operational parameters, each of the components of FRM is designed for application to the management problems of other organizations. Several parts of the FRM system have been implemented and are used on a daily basis at Stanford, while other portions have not yet progressed beyond the planning stage. The FRM architecture allows new modules and applications to be added and integrated to provide increasing functionality as programs are built. The knowledge base is extensible to include heuristics, constraints,and rules that can encode much of the expertise of a human manager as management techniques and goals are better understood.

24324 **(UJV—7639-V) Progress report for 1985.** Havelka, S. (ed.). (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jan 1986. 62p. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87701629.

A summary is presented of the major scientific, technical and economic results achieved by the Institute of Nuclear Research in Rez near Prague in the year 1985. Research and development was mainly oriented to nuclear power: problems of nuclear safety of PWR reactors were studied; experiments were made and evaluated in the field of reactor physics of PWR's, in cooperation with CMEA countries also of fast reactors; the properties were tested of reactor materials under various conditions; in-pile diagnostic techniques were developed for WWER and BN reactors. Research in the field of fuel cycle chemistry was mainly oriented to the treatment of radioactive waste waters and solutions, to the solidification of radioactive wastes, and to the fluoride technology of reprocessing spent fuel from fast reactors. Attention was also devoted to the compilation of technical standards. Also tackled were research problems related to the use of ionizing radiation, such as radiation processing, the research and development of radiopharmaceuticals, neutron activation analysis and neutron radiography. Attention was also devoted to radiation safety. The experimental equipment of the Institute also served the production of radiopharmaceuticals, the development and manufacture of semiconductor detectors, the analysis of samples for the Central Testing Laboratory, and experimental irradiation. The Institute also provided computer and information services. The social programme was oriented to personnel development, housing and catering, health care, the work environment and the recreation of employees. The Institute has achieved good economic results. (J.B.).

24325 **Coping with terrorism.** Kerr, D.M. (Los Alamos National Lab., NM). *Terrorism;* 8: No. 2, 113-126(1985).

Terrorism has emerged as a tool of low-intensity conflict used to undermine Western and moderate governments. There is evidence that the US faces a new threshold of terrorist threat both at home and abroad because the tools are available, media attention is global and often undisciplined, and the motives for terrorist attack span a wide spectrum. The US has no internal consensus of how to respond to acts of terrorism. The goal of the terrorists is to erode faith in the government and the democratic system. The author analyzes the threat and examines opportunities for an adequate response. Among his recommendations are to make infrastructure networks more robust and less vulnerable, the use of new technologies that enhance security, clear guidelines for intelligence gathering and analysis, specially trained response forces, and political moderation and cooperation.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 23519

24326 **(AD-A—175641/0/XAB) Parallel processing of networks. Final technical report.** Deo, N. (Washington State Univ., Pullman (USA)). 15 Nov 1986. 8p. NTIS, PC A02/MF A01.

Recent advancements in hardware technology have made it attractive to use many processors in parallel that cooperate and coordinate their efforts to solve a problem much faster. Such parallel computers are currently being developed, designed, and experimented with. A few, with limited parallelism, are available as commerical products, such as, Intel's iPSC, NCUBE, Sequent's Balance 8000 and 21000. It appears certain that computers are going to be in wide use in 1990's. However, the art of designing parallel algorithms is far behind that of sequential algorithms. The goal of this project was to develop strategies for designing parallel algorithms and computer programs for a certain class of problems consisted of various graph problems that arise on large, sparse, real-life transportation and communication networks. The parallel computer deemed most suited for such problems is a multiple-instruction, multiple-data stream (MIMD) machine.

24327 **(ANL—86-55) Activities and operations of the Advanced Computing Research Facility, July-October 1986.** Pieper, G.W. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006312.

Research activities and operations of the Advanced Computing Research Facility (ACRF) at Argonne National Laboratory are discussed for the period from July 1986 through October 1986. The facility is currently supported by the Department of Energy, and is operated by the Mathematics and Computer Science Division at Argonne. Over the past four-month period, a new commercial multiprocessor, the Intel iPSC-VX/d4 hypercube was installed. In addition, four other commercial multiprocessors continue to be available for research - an Encore Multimax, a Sequent Balance 21000, an Alliant FX/8, and an Intel iPSC/d5 - as well as a locally designed multiprocessor, the Lemur. These machines are being actively used by scientists at Argonne and throughout the nation in a wide variety of projects concerning computer systems with parallel and vector architectures. A variety of classes, workshops, and seminars have been sponsored to train researchers on computing techniques for the advanced computer systems at the Advanced Computing Research Facility. For example, courses were offered on writing programs for parallel computer systems and hosted the first annual Alliant users group meeting. A Sequent users group meeting and a two-day workshop on performance evaluation of parallel computers and programs are being organized.

24328 **(ANL/MCS-TM—87) Experiments with OR-parallel logic programs.** Disz, T.; Lusk, E.; Overbeek, R. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Feb 1987. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006882.

We present here the results of several experiments involving OR-parallelism, based on the implementation of a parallel Warren Abstract Machine at Argonne National Laboratory. The experi-

ments illustrate a variety of effects resulting from various types of programs, and raise issues that must be dealt with in any parallel implementation. We also demonstrate a tool for obtaining a visual representation of the parallelism.

24329 **(CONF-861270—1) NESC [National Energy Software Center] experience with NJE.** Johnson, P.L. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 3p. NTIS MF A01; 2; GPO Dep. File Number DE87007033.

From NJE workshop on NJE; Gif-sur-Yvette, France (10 Dec 1986).

NJE places sixth in the top ten list of NESC best sellers. The category P (General Mathematical and Computing System Routines) is found 5 times on this list. In addition to NJE in this category, there is the computer algebra system DOE-MACSYMA, the general mathematical subroutine library SLATEC, the matrix eigenvalue/vector package EISPACK3, and the simultaneous linear algebraic equation analyzer and solver LINPACK. In category U (Chemistry) can be found the Advanced System for Process Engineering process simulator and economic evaluation package ASPEN and the internal combustion engine fluid dynamics package KIVA. The light water reactor, loss of coolant analysis program RELAP5/MOD1, the building energy analysis program DOE2.1 and the graphics program MAPPER make up the rest of the programs in the top ten list.

24330 **(CONF-870399—1) Formal modeling and analysis of fault-tolerance properties for software.** Chisholm, G.H.; Kljaich, J.; Smith, B.T.; Wojcik, A.S. (Argonne National Lab., IL (USA); Michigan State Univ., East Lansing (USA). Dept. of Computer Science). 1987. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007006.

From 9. international conference on software engineering; Boulder, CO, USA (30 Mar 1987).

This paper describes the application of modeling and analysis techniques to software that is designed to execute on the Charles Stark Draper Laboratory (CSDL) Fault-Tolerant Processor, referred to as the FTP. The work reported here is part of a hardware/software modeling and analysis project. In an earlier paper we have described the hierarchical modeling technique based upon Petri Nets, the formal analysis techniques based upon the automated reasoning software ITP/LMA, and the specific application for which the software was designed. The software performs sensor validation of four independent measures (signals) from the Experimental Breeder Reactor-II operated by Argonne National Laboratory. From the validated signals, a flow trip signal is formulated for the reactor safety system. In the previous paper, we demonstrated fault-tolerance of the FTP's data exchange instructions to failures in the hardware. In this paper, we demonstrate that the same modeling and analysis techniques apply to proving the fault-tolerance of the software in the hardware, provided the validation algorithms have a certain generic structure. The approach that has been developed has provided insight into formal software specification as well as into the generation of test vectors for software and has provided a continuity between specification, design, analysis, and testing.

24331 **(DOE/ER/25026—2) A method for the spatial discretization of parabolic equations in one space variable.** Skeel, R.D.; Berzins, M. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Feb 1987. Contract FG02-87ER25026;AC02-76ER02383. 57p. (UIUCDCS-R—87-1319; UILU-ENG—87-1705). NTIS MF A01; 2; GPO Dep. File Number DE87005991.

The aim of this paper is to describe and analyze a new spatial discretization method for parabolic equations in one space variable: Ordinary and parabolic partial differential equations in one space variable x often have a singularity due to the use of polar cylindrical or spherical coordinates. The method we propose is a simple piecewise nonlinear Galerkin/Petrov-Galerkin method which is second order accurate in space. (It supersedes the method proposed by Skeel). The case m = 1 involves the use of the logarithm function, which is probably the only accurate way to model the logarithmic singularity present in the solution. A code based on a variant of the proposed method has already been included as part of the SPRINT package of Berzins, Dew, and Furzeland. The method that we propose here will be distributed in the next release of the D03P (parabolic equations) section of the NAG Library. 18 refs.

24332 **(ENEA-RT-TIB—86/18) Experience on several devices for a SAS/GRAPH general application sample library.** Vaccari, M. (ENEA, Bologna (Italy). Dipartimento Tecnologie Intersettoriali di Base). 1986. 27p. (CONF-8604302—1). NTIS (US Sales Only), PC A03. File Number DE87900154.

From SEUGI '86: conference of European SAS users; Brighton, UK (15 Apr 1986).

A Contribution to the "SEUGI '86" Conference of European SAS Users, held in Brighton on April 15-18th, 1986 is presented. The paper compares experiences on several devices for the creation of a sample graphical library of SAS/GRAPH applications developed in cooperation with users of different working fields. Examples are discussed and shown, which were made on IBM terminals, Tektronix terminals, plotters like Benson, Calcomp and Nicolet-Zeta.

24333 **(HEDL-SA—3459-FP) Classical computer assisted instruction versus intelligent computer assisted instruction.** Gardner, P.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 1986. Contract AC06-76FF02170. 21p. (CONF-860209—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005463.

From 27. conference of the Association for Development of Computer Based Instructional Systems; New Orleans, LA, USA (3 Feb 1986).

Computer-aided instruction has two basic designs, a classical construction (CCAI) or a design based on the principles of artificial intelligence (ICAI). These two types of instructions are compared and contrasted. (WRF)

24334 (JAERI-M—86-009, pp 147-166) **Some problems on high speed computation of Monte Carlo code.** Asai, Kiyoshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Three computational techniques and computer architectures of vector, scalar parallel and vector parallel processing for computation of neutron transport by the Monte Carlo method are overviewed. Consistencies of the techniques with the current computer architecture, their merits and demerits are also discussed. The vector processing of the neutron transport by Monte Carlo method encounters such obstacles as the low computational density in a statement, many nested conditional branches, indirect addressing, decreasing vector length, recurrence expression, etc. Addition of new pipelines to the current vector processor, however, removes the obstacles to a considerable degree. The scalar parallel processing may be suitable for the Monte Carlo computation when we can provide a number of processors and an amount of memory to each processor. As for the vector-parallel processing, a pipeline parallel processor architecture in which vector processors with a large local memory are linearly connected will be best suitable for high speed computation of the current Monte Carlo codes. This architecture will be the most powerful candidate for the next general purpose super-computer.

24335 (JAERI-M—86-009, pp 167-182) **Numerical methods for vectorization.** Tokunaga, Yasuo. (Fujitsu Ltd., Tokyo, Japan). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Many nuclear codes are hitherto adapted for the vector computer in the JAERI. However, in order to make efficient use of characteristics of the vector computers, in addition to the programming techniques, it is required to rewrite a program adapting a more appropriate numerical methods. This report shows experiences on numerical methods and programmings for the vector com-

puters, which are obtained through vectorizations of programs in the JAERI computer center.

24336 (JAERI-M—86-009, pp 183-195) **GRASYS: a computer program for graphical presentation of nuclear power plant condition.** Ohkubo, Shuji; Fujiki, Kazuo; Kohsaka, Atsuo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

A graphic synthetic system GRASYS which has functions to create, registrate, reference and edit graphical data is presented. On the GRASYS a graph corresponds to a segment. The segment is a set of commands. A complex figure may be created by editing segments in a conventional mode. Time dependent graphs can also be handled as segments. Thus the user can represent the status of a nuclear power plant in case of an accident. GRASYS is made as a general purpose graph handler so that it may be used for other applications.

24337 (JAERI-M—86-009, pp 196-208) **Application of visual simulation technique to nuclear engineering field.** Miwa, Tateo. (Mitsubishi Research Inst., Tokyo, Japan). Mar 1986. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780110. (CONF-8509372—).

From 2. seminar on software development in nuclear energy research; Tokai, Japan (18 Sep 1985).

Various computer simulations are made in the field of nuclear engineering. Results from these simulations are often displayed in graphics, and a plotter-based stop motion picture using vector expression has been mainly employed for this purpose. However, this method is not sufficient when thermal field is to be displayed. Especially when the understanding is required of the macroscopic behavior of the whole system to be analyzed, the colour expression using luster techniques is more appropriate, and the animation method is further desirable. The colour-display of temperature of the thermal fluid and the visual-display of safety analysis simulation for a nuclear power plant are shown as examples. The former shows the results from the thermal hydraulic analysis of the primary coolant system of a reactor by the animation techniques using colour-display. The latter shows an example of a typical visualization of the behaviour of the nuclear power plant at the accident of the primary system. Both these two pictures are very effective for understanding of macroscopic behaviour of the whole system.

24338 (JAERI-M—86-023) **Graphic utilities 'GPREP' and 'LIBGR'.** Hirayama, Toshio; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1986. 69p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87701586.

Plotting utilities, which are widely appreciable to problems of computational physics, have been developed as a part of a library system for a one dimensional tokamak transport code. Utility routines are composed of two procedures, i.e., the pre-processor "GPREP" registrates graphic data to a data file with a set format, and "LIBGR" processes the data to match with the required format of "ARGUS" and plots the graph. The regular form of data by "GPREP" enables us to read out data without any information on data recording so that these utilities are very usefull for dealing with a lot of disorder data with different type.

24339 (LA—10829-MS) **REZONE: A method for automatic rezoning in two-dimensional Lagrangian hydrodynamics problems.** Wallick, K.B. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87006324.

A method for automatic rezoning in two-dimensional Lagrangian hydrodynamics problems is described. This method conserves mass, internal energy, and directed kinetic energy as these quantities are transferred from one zone to another. The general procedure is to run the problem hydrodynamically while monitoring the mesh for distortion. When the distortion becomes severe, the problem is interrupted and the REZONE code takes over to clear up the mesh distortion. This process is continued as needed during the entire run of the problem. Only those areas of the mesh that show distortion are rezoned. The purpose of this method is to keep hydrodynamic problems running while disturbing the normal calculations as little as possible. With this method the overall shape of the mesh will still indicate the natural flow of the hydrodynamics problems. 4 refs., 78 figs.

24340 (LA-UR—87-87) **The S/sub N//Monte Carlo response matrix hybrid method.** Filippone, W.L.; Alcouffe, R.E. (Los Alamos National Lab., NM (USA); Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering). 1987. Contract W-7405-ENG-36. 16p. (CONF-870424—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005112.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

A hybrid method has been developed to iteratively couple S/sub N/ and Monte Carlo regions of the same problem. This technique avoids many of the restrictions and limitations of previous attempts to do the coupling and results in a general and relatively efficient method. We demonstrate the method with some simple examples.

24341 (LA-UR—87-352) **Pattern selection and competition in near-integrable systems.** Bishop, A.R.; McLaughlin, D.W. (Los Alamos National Lab., NM (USA); Arizona Univ., Tucson (USA)). 1986. Contract W-7405-ENG-36. 32p. (CONF-8608163—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006068.

From Structure, coherence, and chaos in dynamical systems conference; Lyngby, Denmark (1 Aug 1986).

Pattern selection and competition in certain near-integrable systems are discussed. These systems provide models for controlled studies of low dimensional attractors in high (infinite) dimensional systems. Four examples from damped, driven pendulum rings are summarized in the order of increasing spatial complexity of their chaotic attractors. These examples illustrate the use of numerical and analytical techniques from soliton mathematics to study properties of chaotic attractors. In particular, the connection of (unperturbed) homoclinic states with instabilities of spatial patterns, with interactions between patterns, and as possible sources of temporal chaos is emphasized. 16 refs., 9 figs.

24342 (LA-UR—87-673) **Parallel graph reduction on a supercomputer: A status report.** Michelsen, R.; Smith, L.; Williams, E.; Yantis, B. (Department of Defense, Ft. Meade, MD (USA); Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-8610257—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87006066.

From Santa Fe graph reduction workshop; Santa Fe, NM, USA (1 Oct 1986).

We describe an ongoing effort to develop a parallel graph reduction run-time system hosted on a multiprocessor supercomputer. This run-time system is presently augmented by the functional language compiler of the ALFALFA system. Admittedly, parallel graph reduction is hardly a novel idea. The interesting notion is the provision of a parallel execution environment sufficiently powerful to support development of large prototypical scientific and symbolic codes in a functional language. This will allow the investigation of the functional programming paradigm within these application domains in an empirical fashion. In this paper, we discuss the motivation for the effort, describe the basic elements of the implementation, and provide some preliminary insight distilled from our experience with an initial version of the run-time system.

24343 (NORDITA—84/47-Prepr.) **Technique for filling gaps in time series with complicated power spectra.** Brown, T.M.; Christensen-Dalsgaard, J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87751246.

Fahlman and Ulrych (1982) describe a method for estimating the power and phase spectra of gapped time series, using a maximum-entropy reconstruction of the data in the gaps. It has proved difficult to apply this technique to solar oscillations data, because of the great complexity of the solar oscillations spectrum. We describe

a means for avoiding this difficulty, and report the results of a series of blind tests of the modified technique. The main results of these tests are: 1. Gap-filling gives good results, provided that the signal-to-noise ration in the original data is large enough, and provided the gaps are short enough. For low-noise data, the duty cycle of the observations should not be less than about 50%. 2. The frequencies and widths of narrow spectrum features are well reproduced by the technique. 3. The technique systematically reduces the apparent amplitudes of small features in the spectrum relative to large ones.

24344 (ORNL/RSIC—13-Vols.1-3-Rev.) Abstracts of digital computer code packages assembled by the Radiation Shielding Information Center. Carter, B.J.; Maskewitz, B.F. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 286p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87006393.

This publication, ORNL/RSIC-13, Volumes I to III Revised, has resulted from an internal audit of the first 168 packages of computing technology in the Computer Codes Collection (CCC) of the Radiation Shielding Information Center (RSIC). It replaces the earlier three documents published as single volumes between 1966 to 1972. A significant number of the early code packages were considered to be obsolete and were removed from the collection in the audit process and the CCC numbers were not reassigned. Others not currently being used by the nuclear R and D community were retained in the collection to preserve technology not replaced by newer methods, or were considered of potential value for reference purposes. Much of the early technology, however, has improved through developer/RSIC/user interaction and continues at the forefront of the advancing state-of-the-art.

24345 (PB—87-134581/XAB) High parallelism and an effective reasoning procedure. Kung, C.H. (Trondheim Univ. (Norway). Computing Centre). 3 Mar 1986. 28p. NTIS, PC PC E04/MF E04.

Published as Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway) rept. no. STF14-A86026.

The paper presents a reasoning procedure characterized by high parallelism in the sense that an unlimited number of CPU's can be used to carry out the computation in parallel. It is an indirect-proof method based upon Prawitz's work and Robinson's unification algorithm. The method is characterized by bit manipulation rather than symbol manipulation. Its parts can be implemented by VLSI pipelines.

24346 (PB—87-137196/XAB) Agenda for improved evaluation of supercomputer performance. Final report. (National Research Council, Washington, DC (USA)). 1986. 66p. NTIS, PC A04/MF A01.

A substantial scientific community and body of literature are devoted to computer performance measurement and evaluation. Impressive successes have been achieved in theory, prediction, and experimentation for systems that have sequential architecture and applications that involve data handling and manipulation. Less successful and mature are the methods and measurements for evaluation of systems performance when scientific problems are run on supercomputers of diverse architectural characteristics. The complexity of these systems, together with the increasing diversity of computing architectures becoming available, makes evaluation of supercomputer performance more problematical, yet more important, than for the more-common midrange computer systems. Moreover, what is learned about the performance of operational systems can be expected to guide the design of future systems.

24347 (RFP—4059) Computer-Aided-Instruction (user/CSO computer security training). Twyman, J.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 5p. (CONF-870565—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87004894.

From Department of Energy computer security group conference; Albuquerque, NM, USA (5 May 1987).

This paper discusses a Computer-Aided-Instruction (CAI) course that has been implemented at Rocky Flats. Trying to train 2000 computer users and Computer Security Officers (CSO) has been a real dilemma at Rocky Flats. In order to resolve this problem, our Training Department implemented a CAI training course on Computer Security. Presently, we are training approximately 100 users/CSOs per month, and soon these numbers should increase. The duration of the User course is about an hour and the CSO's is about an hour and a half. CAI is being used on the unclassified VAX computer system in conjunction with IBM PC XTs.

24348 (RFP—4084) Statistical applications at Rocky Flats. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1987]. Contract AC04-76DP03533. 19p. NTIS, PC A02. File Number DE87007050.

After three years as an industrial statistician with Rockwell International at Rocky Flats Plant (RFP), engaging in general statistical consulting, the speaker has faced a wide and varied range of statistical problems. The various applications at RFP touch all areas of statistics including experimental design, sampling, calibration problems, sequential testing and loutliner detection. The speaker will describe several interesting problems he has worked on and discuss the difficulties sometimes encountered at RFP. In conclusion the speaker will evaluate how well his education and training has prepared him for his present line of work. It is hoped this will stimulate discussion from the audience on how to best train a statistician for statistical consulting in industry.

24349 (SAND—87-0256C) Random functions and their small cycles. DeLaurentis, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870255—1). NTIS, PC A02. File Number DE87005850.

From 18. southeastern international conference on combinatorics: graph theory computing; Boca Raton, FL, USA (23 Feb 1987).

Random functions often arise as a model for the pseudo-random functions generated by cryptosystems. The directed graph which is naturally associated with each random function γ is the graph having a vertex for each element of the domain and a directed edge from vertex i to vertex j if $\gamma(i) = j$. The components of such a graph consist of a cycle with trees attached to the nodes of the cycle. A number of experiments which involve pseudo-random functions select an initial vertex at random and then iterate the function until a cycle is detected. (WRF).

24350 (SAND—87-0489) An IGES electrical test: CADCAM-035. Parks, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007525.

It is now possible to exchange electrical design, documentation, and manufacturing data using IGES. This report discusses the results of processing a version 2.0 IGES electrical test file into a particular CAD system environment and the resulting data exchange issues.

24351 (UCID—20935) Supercomputer environments for hardware and software technology forecast. Mendicino, S.F. (ed.). (Lawrence Livermore National Lab., CA (USA)). 30 Dec 1987. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007523.

The price-performance revolution in microelectronics and the development of cost-effective communication networks have set the stage for an integrated view of large-scale computing. In the next decade, the supercomputer, the mass storage system, the communication network, and the interactive "front ends" will be viewed as elements of a total hardware environment whose resources are managed by a single distributed operating system. Since much of the burden of providing effective service in such an environment is placed on software, this report describes not only what potentially lies ahead in the various hardware areas, but also operating systems and related software will evolve over the next decade to complement the hardware.

24352 **(UCID—21011-Vol.1) System survey report for DOEDEF Translator Module Pool A: Volume 1.** Wimple, C. (Lawrence Livermore National Lab., CA (USA)). 17 Feb 1987. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007518.

The Department of Energy Data Exchange Format (DOEDEF) Translator Module Pool A (hereafter referred to as the "pool") is intended to reduce the manpower required to rewrite the DOEDEF translator software already in existence throughout the Department of Energy Nuclear Weapons Complex (DOE NWC). Each portion of the DOEDEF exchange system and therefore each site's DOEDEF translator software must be rewritten during the transition from Phase 1.0 to Phase 1.5 of DOEDEF. By providing a pool, some of which (if not all) can be used by multiple NWC sites, the effort required to move from Phase 1.0 to Phase 1.5 can be reduced.

24353 **(UCRL—53783) Identifying and selecting a computerized image editing/processing system.** Barrow, R.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006902.

Within the Defense Sciences Department at LLNL there was a critical need for production of professional quality viewgraphs for various Department presentations. The current process was both time consuming and costly because editing and redrawing of designs were done by hand; thus this study was made both at LLNL and with various computer companies outside the Laboratory, to examine computer systems that would be applicable to producing high quality viewgraphs in a short turn-around time. An extensive literature research and informal interviews were conducted on-site with middle and upper management, technical illustrators and artists, drafting supervisors, and security personnel, and off-site with company suppliers and vendors of computer systems' hardware and software. The conclusion was drawn that the desk-top Macintosh Plus was the current optimum system available.

24354 **(UCRL—96070) Patterns from models of dissipative systems.** Keller, P.; Duong-van, M. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 4p. (CONF-870159—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006823.

From International conference on physics of chaos and systems far from equilibrium; Monterey, CA, USA (11 Jan 1987).

We use various computer graphics techniques to study complex systems - computer graphics help us to decide what and how to measure. We use a recursion relationship as a way of generating instabilities and turbulence on a two-dimensional lattice. We have been successful in recovering many patterns observed in recent experiments, and mathematical analyses of some experiments also corroborate the mathematical analyses of some of our pictures.

24355 **An investigation into the use of "expert systems" for system-wide diagnostics.** Booth, A.W.; Carroll, J.T. (Fermi National Accelerator Lab., MS 223, P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 151-156(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

This paper has explained how expert systems function and how they might be used to provide a FASTBUS system-wide diagnostic program. The authors propose that the system be used to diagnose the FASTBUS system at FERMILAB's CDF experiment. There are many important areas which have not been addressed in great detail in this paper (such as the roles of the knowledge engineer and the expert during the knowledge acquisition phase), but the central idea of the embodiment of an expert skill in a computer is clear. Development of a system-wide diagnostic program requires building knowledge from all our system experts, into the system. To expand the expert system beyond its network diagnostic ability, to include finding faulty modules would be worthwhile. Having an "intelligent" assistant who is on shift 24 hours each day would relieve the "real" experts from laborious, time-consuming and sometimes repetitive tasks undertaken during the debugging process. The system could also provide a testbed for evaluation and comparison when considering future expert-system applications such as "run-control" and "data analysis". In the context of a system-wide diagnostic program, an "expert system" is not intended to replace human experts but simply to help them. It is envisaged that there will always be important interaction between the human expert and the "expert system". The incremental development of the "expert system" should ensure that it is useful in the short term (by debugging to the S.I./segment level for example), and even more useful in the medium to longer term as it acquires more and more knowledge and the ability to debug to the module level. Expert systems exist and are working successfully in many problem domains. See the bibliography for examples of "expert systems" built in the high energy physics environment.

24356 **Review of the status of the fastbus standard routine specification.** Pordes, R. (Computing Dept., Fermilab, P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 162-165(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

Within the next few months the FASTBUS Software Working group hopes to distribute the Specification for Standard Routines for FASTBUS. The draft specification will go to the members of the overseeing NIM committee for review. This paper presents the current status of the specification. It includes a list of the goals of the specification; some details of the concepts embedded in it; as well as an overview of the software implementations of the previously distributed draft versions of the specification.

24357 **The Enhanced Segment Interconnect for FASTBUS data communications.** Machen, D.R.; Downing, R.W.; Kirsten, F.A.; Nelson, R.O. (Scientific Systems International, Los Alamos, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 1, 166-169(Feb 1987). (CONF-861007—).

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

The Enhanced Segment Interconnect concept (ESI) for improved FASTBUS data communications is a development supported by the U.S. Department of Energy under the Small Business Innovation Research (SBIR) program. The ESI will contain both the Segment Interconnect (SI) Tyhpe S-1 and an optional buffered interconnect for store-and-forward data communications; fiber-optic-coupled serial ports will provide optional data paths. The ESI can be applied in large FASTBUS-implemented physics experiments whose data-set or data-transmission distance requirements dictate alternate approaches to data communications. This paper describes the functions of the ESI and the status of its development, now 25% complete.

24358 **Almost sure stability of linear stochastic systems with poisson process coefficients.** Li, C.W.; Blankenship, G.L. (Dept. of Mathematical Studies, Hong Kong Polytechnic, Hung Hom, Kowloon, Hong Kong). *SIAM Journal on Applied Mathemadics;* **46**: No. 5, 875-911(Oct 1986).

The authors consider the problem of determining the sample path stability of a class of linear stochastic differential equations with point process coefficients. Necessary and sufficient conditions are obtained which are similar to those derived by a previous study for diffusion processes. The conditions are based on theorems on the asymptotic behavior of products of random matrices. Estimates on the probabilities of large deviations for stable processes are also given, together with a result on the stabilization of unstable systems by feedback controls.

24359 **Parallel supercomputing today and the cedar approach.** Kuck, D.J.; Davidson, E.S.; Lawrie, D.H.; Sameh, A.H. (Univ. of Illinois, Urbana). *Science (Washington, D.C.);* **231**: 967-974(28 Feb 1986). Contract FG02-85ER25001.

More and more scientists and engineers are becoming interested in using supercomputers. Earlier barriers to using these machines are disappearing as software for their use improves. Meanwhile, new parallel supercomputer architectures are emerging that may provide rapid growth in performance. These systems may use

a large number of processors with an intricate memory system that is both parallel and hierarchical; they will require even more advanced software. Compilers that restructure user programs to exploit the machine organization seem to be essential. A wide range of algorithms and applications is being developed in an effort to provide high parallel processing performance in many fields. The Cedar supercomputer, presently operating with eight processors in parallel, uses advanced system and applications software developed at the University of Illinois during the past 12 years. This software should allow the number of processors in Cedar to be doubled annually, providing rapid performance advances in the next decade. 43 references, 4 figures.

24360 ANL/Star project: a new architecture for large scale theoretical physics computations. Rushton, A.M. (Argonne National Lab., IL). pp 370-374 of Computing in high energy physics. Proceedings of the conference held in Amsterdam, The Netherlands, 25-28 June, 1985. Hertzberger, L.O.; Hoogland, W. (eds.). Amsterdam, Netherlands; North-Holland (1986). (CONF-8506157—).

From Conference on computing in high energy physics; Amsterdam, Netherlands (25 Jun 1985).

The project consists of two phases, each of which has goals of substantial physics content on its own. In phase I, Star Technologies' ST-100 was selected as the array processor for the prototype coupled system and was installed on a Vax II/750 host. The goals with this system are to institute a substantial program in computational physics at Argonne based on the power provided by this system and thereby to gain experience with both the hardware and software architecture of the ST-100. In Phase II, it is proposed to build a prototype consisting of two coupled array processors with shared memory to prove that this design can achieve high speed and efficiency in a readily extensible and cost-effective manner. This will implement all of the hardware and software modifications necessary to extend this design to as many as 64 (or more) nodes. First the architecture of the ST-100 is discussed. Then the physics program currently being implemented on a single system is described. Finally the proposed design of the coupled system is presented. (Auth.).

24361 Computer-graphic visualization of dynamics. Stewart, H.B. (Brookhaven National Lab., Upton, NY). *Transactions of the American Nuclear Society;* **53**: 243-244(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

As engineered systems become increasingly sophisticated and complex, questions of efficiency, reliability, and safety demand the application of more powerful methods of analysis. One indication of this is the accelerating trend away from purely static or quasi-steady system modeling toward models that include essentially dynamic behavior. It is here that the qualitative ideas of nonlinear dynamics, dealing as they do with the most typical behavior in real dynamical systems, can be expected to play an increasingly prominent role. As part of a continuing investigation of the most important low-order differential equations, an interactive computer graphics environment has been created for the study of systems in three-dimensional phase space. This environment makes available the basic control of both numerical simulation and graphic visualization by a specially designed menu system. A key ingredient in this environment is the possibility of graphic communication not only from machine to man, but also from man to machine. Thus to specify the starting point for a numerical integration, for example, the user points to a location in phase space on the screen of the graphics terminal (using crosshairs or a mouse and cursor), bypassing the necessity to give numerical values of the phase-space coordinates. By devising a flexible computer interface which implements conceptual approaches to phase-space analysis of dynamical systems, significant advances in understanding of prototypical differential equations have been achieved.

24362 Oscillation criterion for linear second-order differential systems. Atkinson, F.V.; Kaper, H.G.; Kwong, M.K. *Proceedings of the American Mathematical Society;* **94**: No. 1, 91-96(May 1985). Contract W-31-109-ENG-38.

This article is concerned with the oscillatory behavior at infinity of the solution y: [a, ∞) → R/sup n/ of a system of n second-order differential equations, y″(t) + Q(t)y(t) = 0, t epsilon [a, ∞); Q is a continuous matrix-valued function on [a, ∞) whose values are real symmetric matrices of order n. It is shown that the solution is oscillatory at infinity if (at least) n - 1 eigenvalues of the matrix integral/sub a//sup t/Q(t) dt tend to infinity as t → ∞. 7 references.

24363 Perspectives on superconducting. Buzbee, B.L.; Sharp, D.H. (Los Alamos National Lab., NM). *Science (Washington, D.C.);* **227**: No. 4687, 591-597(8 Feb 1985).

This article provides a brief look at the current status of supercomputers and supercomputing in the US. It addresses a variety of applications of supercomputers and the characteristics of a large modern supercomputing facility, the radical changes in the design of supercomputers that are impending, and the conditions that are necessary for a conducive climate for the further development and application of supercomputers. 15 references, 3 figures, 3 tables.

24364 Role of linear recursive estimators in time series forecasting. Pack, D.J.; Pike, D.H.; Downing, D.J. (Oak Ridge National Lab., TN). *Management Science;* **31**: No. 2, 188-190(Feb 1985). Contract AC05-84OR21400.

This paper presents a descriptive synthesis of a number of a linear recursive estimator (LRE) procedures for time series forecasting, i.e., procedures which involve parameter updates proportional to the last period forecast error. It is stressed that both constant and variable parameter procedures exist among LRE's. General requirements for stability of parameter estimates are given, as are general forms for parameter covariance matrices that appear in forecast variance determinations. Procedures explicitly considered are the Kalman filter, dynamic autoregression, the Carbone-Longini adaptive estimation procedure, generalized least squares, Widrow's least mean square, and the Makridakis-Wheelwright generalized adaptive filtering. 11 references.

24365 Oscillation of two-dimensional linear second-order differential systems. Kwong, M.K.; Kaper, H.G. (Argonne National Lab., IL). *Journal of Differential Equations;* **56**: No. 2, 195-205(Feb 1985). Contract W-31-109-ENG-38.

This article is concerned with the oscillatory behavior at infinity of the solution y: [a, ∞) → R^2 of a system of two second-order differential equations, y″(t) + Q(t) y(t) = 0, t epsilon[a, ∞); Q is a continuous matrix-valued function on [a, ∞) whose values are real symmetric matrices of order 2. It is shown that the solution is oscillatory at infinity if the largest eigenvalue of the matrix integral/sub a//sup t/ Q(s) ds tends to infinity as t → ∞. This proves a conjecture of D. Hinton and R.T. Lewis for the two-dimensional case. Furthermore, it is shown that considerably weaker forms of the condition still suffice for oscillatory behavior at infinity. 7 references.

24366 Optimal solution for maximizing the probability of retention in PPS sampling. Wright, T.; Tsao, H. (Oak Ridge National Lab, TN). *Linear Algebra and Its Applications;* **67**: 67-80(1985). Contract AC05-84OR21400.

A direct alternative proof of Keyfitz's optimal solution to the problem of maximizing the probability of retention in sampling on a second occasion is given, using techniques of elementary linear algebra. The proof and comments help one to better understand Keyfitz's solution, and they clearly demonstrate that the closed form solution of Keyfitz is one of a possible infinity of solutions offered by a linear programming approach. The authors also give one of those other solutions offered by linear programming, which is easy to obtain by hand calculations using only the operation of subtraction. 11 references, 4 tables.

24367 A simulation and experimental method on planning and execution of straight line manipulator trajectories. Sze, J.S.; Wang, J.C. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 591-598 of Proceedings of the 16th annual Pittsburgh conference on modeling and simulation. Hanham, R.; Vogt, W.G.; Mickie, M.H. Pittsburgh, PA; University of Pittsburgh (1985). (CONF-8504134—).

From 16. Instrument Society of America modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1985).

The manipulation of the end-effector of industrial robots in general is specified by passing through a sequence of points in Cartesian space to accomplish given tasks. The effectiveness of such motion specifications will greatly increase if the end-effector moves in a straight line between the specified points. The fundamental difficulty in achieving straight line motion is that the linear interpolation between the joint space description of two points does not achieve Cartesian space straight line motion, and conversely. By using computer simulation techniques, the Cartesian path motion can be obtained. This paper discusses a method of planning and executing a Cartesian path manipulation by using a microcomputer. In the motion planning operation the kinematic equations are solved. A simulation subroutine is used to predict the deviation from the desired straight line path that may be generated from the linear interpolation of joint space. A microprocessor is used to generate and to execute the linear interpolation subroutine which performs an open loop control of six stepping motors. An experimental technique has also been developed to verify the simulation subroutine and to examine the actual deviation that may be generated due to mechanical vibration and/or friction during motion execution.

24368 **Projection pursuit density estimation.** Friedman, J.H.; Stuetzle, W.; Schroeder, A. (Stanford Univ., CA). *Journal of the American Statistical Association;* **79**: No. 387, 599-608(Sep 1984). Contract AC03-76SF00515;AT03-81ER10843.

The projection pursuit methodology is applied to the multivariate density estimation problem. The resulting non-parametric procedure is often less biased than the kernal and near-neighbor methods. In addition, graphical information is produced that can be used to help gain geometric insight into the multivariate data distribution. 13 references, 6 figures, 2 tables.

24369 **Squeezing the most out of an algorithm in CRAY FORTRAN.** Dongarra, J.J.; Eisenstat, S.C. (Argonne National Lab., IL). *ACM Transactions on Mathematical Software;* **10**: No. 3, 219-230(Sep 1984). Contract W-31-109-ENG-38.

This paper describes a technique for achieving supervector performance on a CRAY-1 in a purely FORTRAN environment. The technique can be applied to a wide variety of algorithms in linear algebra, and is beneficial in other architectural settings. 6 references, 4 tables.

24370 **Interesting property of the sample mean under a first-order autoregressive model.** Morris, M.D.; Ebey, S.F. (Oak Ridge National Lab., TN). *American Statistician;* **38**: No. 2, 127-129(May 1984). Contract W-7405-ENG-26.

The unweighted sample mean is examined as an estimator of the population mean in a first-order autoregressive model. It is demonstrated that the precision of this estimator deteriorates as the number of equally spaced observations taken within a fixed time interval increases. 2 references, 2 tables.

24371 **Oscillation of linear second-order differential systems.** Kwong, M.K.; Kaper, H.G.; Akiyama, K.; Mingarelli, A.B. (Northern Illinois Univ., Dekalb). *Proceedings of the American Mathematical Society;* **91**: No. 1, 85-91(May 1984). Contract W-31-109-ENG-38.

This article is concerned with the oscillatory behavior at infinity of the solution y:[a, ∞) → R/sup n/ of a system of second-order differential equations, y″(t) + Q(t)y(t) = 0, t epsilon [a, ∞); Q is a continuous matrix-valued function on [a, ∞) whose values are real symmetric matrices of order n; it is assumed that the largest eigenvalue of the matrix integral/sub a//sup t/Q(s)ds tends to infinity as t → ∞. Various sufficient conditions are given which guarantee oscillatory behavior at infinity; these conditions generalize those of Mingarelli. 10 references.

24372 **(LA-tr—87-7) Development and performance evaluation of a finite element simulator using parallel processing array (PPA).** Doi, Shun. Translated from *Transactions of the Information Processing Society of Japan ;* **25**: No. 3, 379-387(1984). Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006227.

This article introduces the primary concepts, and discusses the performance evaluation of a finite element simulator which has been developed for increased speed in the high speed solution of partial differential equations, and which is based on a parallel processor array (PPA) consisting of a one-dimensional array comprised of 34 miniprocessors. The object of this simulator is a heat transfer system, but the data entered into this system is essentially no different from the data entered into a conventional finite element solution system, and the user is not required to be absolutely conscious of the parallel computations. In the performance evaluation, it is shown that computation speed was increased, the speed of computation by this simulator being nearly proportionate to the number of processors used, and that computation time was increased only proportionate to the number of nodes as long as there was a sufficient number of processors. Furthermore, through comparison to simulations by a general purpose, large scale computer (HITAC-M-200) through several computation methods using its internal array processor (IAP), it was shown that this simulator was by no means inferior from the point of computation speed, and that it was in fact a great deal superior in performance cost comparisons. Finally, to what extent the number of processors could be practically increased with respect to the scale of the finite element model when expanding the PPA in the emphasis of finite element simulation was considered. Those results made it clear that the number of processors could be increased up to about 400 when handling problems involving up to approximately 20,000 node points, and that it was possible to attain the amount of memory in the data range required by each of those processors in this case with microprocessors which are currently on the market.

24373 **Dynamically partitionable multicomputers with switchable memory.** Su, S.Y.W.; Baru, C.K. (Univ. of Florida, Gainesville). *Journal of Parallel and Distributed Computing;* **1**: 152-184(1984). Contract FG05-84ER13285.

From IEEE international conference on data engineering; Los Angeles, CA, USA (24-27 Apr 1984).

This paper presents an analysis and evaluation of a multicomputer system called SM3 which has a number of special architectural features, viz.: (1) a number of independent computer systems interconnected by a physically partitionable bus which allows the system to be dynamically reconfigured into a number of clusters (or subnetworks) of adjacent computers to achieve a high degree of parallel, MIMD processing; (2) a set of dual switchable main memory modules used to facilitate fast data/command/message transfers among the computers; and (3) a number of special-purpose control lines for efficient interprocessor control, communication, and synchronization. Three representative database algorithms are described and modeled analytically by a set of timing equations and the results of a performance evaluation study are presented. The performance of the SM3 architecture is compared with that of several existing architectures. It is found that SM3 has an excellent overall performance for various categories of database operations and that its architecture is flexible for adapting different software algorithms. 38 references, 5 figures, 3 tables.

24374 **Graph-theoretic measures of multivariate association and prediction.** Friedman, J.H.; Rafsky, L.C. (Stanford Univ., CA). *Annals of Statistics;* **11**: No. 2, 377-391(1983). Contract AC03-76SF00515.

Interpoint-distance-based graphs can be used to define measures of association that extend Kendall's notion of a generalized correlation coefficient. The authors present particular statistics that provide distribution-free tests of independence sensitive to alternatives involving non-monotonic relationships. Moreover, since ordering plays no essential role, the ideas that fully applicable in a multivariate setting. The authors also define an asymmetric coefficient measuring the extent to which (a vector) X can be used to make single-valued predictions of (a vector) Y. The authors discuss various techniques for proving that such statistics are asymptotically normal. As an example of the effectiveness of their approach, the authors present an application to the examination of residuals from multiple regression. 18 references, 2 figures, 1 table.

24375 **Derivative calculation from finite element solutions.** Carey, G.F. (Univ. of Texas, Austin). *Computer Methods in Applied Mechanics and Engineering;* **35**: 1-14(1982). Contract AS05-81ER10954.

A technique is considered whereby very accurate derivatives of a finite element solution can be calculated efficiently. It is demonstrated here that most of the necessary quantities for this subsidiary computation are available as computed by-products in the preceding finite element solution procedure. The calculation is shown in this note to be a particular form of a procedure for which superconvergent theoretical error estimates have been proven elsewhere. Numerical experiments confirm the superior accuracy in the computed derivative (stress or flux). 9 references, 5 figures, 8 tables.

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REFER ALSO TO CITATION(S) 22162, 22818

24376 (CONF-870538—3) A disaster in retrospect: Hope for the future?. Kenski, D.M. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004966.

From 34. international technical communication conference; Denver, CO, USA (10 May 1987).

This paper describes a recent editorial disaster that befell our staff, the steps we took to cope, and the lessons we learned. A complex, poorly written report was submitted for editing and production on a tight schedule. The authors, who were new to the department's publishing process, were unusually hostile to the editing function. Despite calling in managers, holding meetings of all involved, and patiently explaining editorial policy and principles, the report became mired in endless rounds of author-editor negotiations and ended up being published 3 months late. Some important lessons we learned: introduce new authors to the editorial process with special care; always develop written schedules; document your time; bring in management at whatever level is necessary. Even if you do your best, it may occasionally be necessary to lower your standards, get a nasty job done as quickly as possible, and move on to more profitable tasks. Remember that the burden of technical correctness lies with the author - the editor's job is to point out errors and suggest corrections; the author must in the end decide whether to accept those corrections.

24377 (DOE/ER/25026—1) Differential-algebraic equation index transformations. Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1986. Contract FG02-87ER25026. 19p. (UIUCDCS-R—86-1314; UILU-ENG—86-1780; CONF-870726—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005543.

From 1. international conference on industrial and applied mathematics; Paris, France (1 Jul 1987).

Techniques are discussed for the reduction of higher index problems of general differential-algebraic equations by differentiation to lower index ones that can be solved numerically while not introducing any constants of integration. Furthermore, we will give transformations between general DAEs and ones in semi-explicit form, and, by these techniques, show how a problem can be reduced to an index 1 semi-explicit form that can be reduced to an implicit differential equation from whose solution the solution to the original problem can be retrieved by at most a differentiation and a linear transformation. 9 refs.

24378 (INIS-mf—10347) Karlsruhe Nuclear Research Centre. Report on the results of research and development 1985. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 15 May 1986. 484p. (In German). NTIS (US Sales Only), PC A21/MF A01. File Number DE87751343.

The report contains a description of the research projects, a list of the institutes and departments of the scientific-technical range with short articles concerning the results of the institutional work, and a bibliography of all publications of 1985. The main aspects of the projects and research programs are fast breeder, separation nozzle process, nuclear fusion, waste recycling and reprocessing, final storage, nuclear safety, the range of technique-man-environment, solid state and materials research, nuclear and elementary particle physics, and research programs of different institutes.

24379 (INIS-mf—10535) Subject directed project catalogues. A catalyst in Nordic cooperation?. Bonnevie-Svendsen, M. (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). Feb 1986. 35p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750686.

In a Nordic project an attempt has been made to establish a Nordic catalogue for ongoing projects in the radioactive waste field. To evaluate the practical implications of such a catalogue, a speciem copy containing about 150 projects has been issued. On the basis of a positive response from users, guidelines for annual publication were drawn up, but no decision has been made with regards to further editions. Suggestions for a future coordination with IAEA/WMRA have been outlined.

24380 (LBL—21747) Physical design of temporal databases. Rotem, D.; Segev, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 22p. (CONF-870261—1). NTIS, PC A02. File Number DE87006146.

From 3. international conference on data engineering; Los Angeles, CA, USA (2 Feb 1987).

We propose a partitioning scheme of files in a temporal database system, and develop algorithms to minimize the overflow associated with that scheme. The proposed partitioning is suitable for range queries and aggregation operations along the time dimension. Simulation results show that the partitioning algorithms proposed in this paper result in better performance than in the case of a grid-type partitioning. 18 refs., 6 figs., 2 tabs.

24381 (LBL—22848) Batched interpolation searching on databases. Li, Jian-zhong; Wong, H.K.T. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 16p. (CONF-870261—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006932.

From 3. international conference on data engineering; Los Angeles, CA, USA (2 Feb 1987).

This paper examines the effect of batching search requests in the Interpolation Search Algorithm on ordered tables in main-memory as well as in a more typical database environment, i.e., a blocked secondary memory. Experiments are performed on several hybrid interpolation search algorithms over non-uniformly distributed data. The effect of batching on these algorithms is examined in terms of algorithms, analysis and experiments. Algorithms, analytic expressions and experimental results of these extensions are given and described. Analytic expressions of these algorithms are validated by experiments. 16 refs., 7 figs.

24382 (UCRL—96032) Livermore risk analysis methodology: A structured decision analytic tool for information systems risk management. Guarro, S.B. (Lawrence Livermore National Lab., CA (USA)). 16 Jan 1987. Contract W-7405-ENG-48. 20p. (CONF-8611117—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006825.

From Annual meeting of the Society for Risk Analysis; Boston, MA, USA (9 Nov 1986).

Reflections on information security risk analysis and a description of the basic features of LRAM, a specific risk analysis methodology developed at the Lawrence Livermore National Laboratory are discussed.

9904 Law

24383 (INIS-mf—10588) Act on state surveillance over nuclear safety of nuclear facilities and related regulations. Kyncl, J. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). Mar 1986. 80p. (In Czech). NTIS (US Sales Only), PC A05/MF A01. File Number DE87701625.

The full text is given of Act of Law No. 28/1984 Coll. of Laws concerning State Surveillance over Nuclear Safety of Nuclear Facilities, an excerpt from Act of Law No. 115/1983 Coll. of Laws which amends Act of Law No. 133/1970 Coll. of Laws on the competence of federal minstries, excerpt from Act of Law No. 50/1976 Coll. of Laws concerning regional planning and the building law, excerpts from Notice No. 85/ 1976 Coll. of Laws on the detailed arrangement of regional proceedings and the building law,

excerpts from Notice No. 83/1976 Coll. of Laws on general technical requirements for the construction, excerpts from Notice No. 105/1981 Coll. of Laws on the documentation of structures, Decree No. 2/1978 concerning nuclear safety assurance in the design, licensing and implementation of structures with nuclear power equipment, Decree No. 4/1979 concerning general criteria of nuclear safety provision in siting structures with nuclear power equipment, Decree No. 5/1979 concerning quality assurance of selected nuclear power installations, Decree No. 6/1980 on nuclear safety assurance in the start-up and operation of nuclear power installations, Instruction of the Czechoslovak Atomic Energy Commission No. 1/1985 determining the manner, time-limits and conditions of certifying the qualifications of selected personnel including the issuance and withdrawal of such certification, Decree No. 9/1985 on assuring nuclear safety of research nuclear installations and Notice No. 28/1977 Coll. of Laws on nuclear materials accounting and control. (J.B.).

24384 **(SIS—1986:6) Nuclear emergency planning in Norway.** Baarli, J. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750694.

The report describes the nuclear emergency plans before the Chernobyl accident. Revised plans are now being prepared.

The nuclear emergency planning in Norway is forming a part of the Search and Rescue Service of the country. Due to the fact that Norway do not have any nucleat power reactor, the nuclear emergency planning has not been given high priority. The problems however are a part of the activity of the National Institute of Radiation Hygiene, and the emergency preparedness is at the present time to a large extent based on the availability of professional health physicists and their knowledge, rather than established practices.

CORPORATE AUTHOR INDEX

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Title, (supplementary information), citation number, (R;US)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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Research Programs
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See also TELEPHONES

Electric Filters
Documentation of computer programs for optimization and simulation of multicarrier SAW-based demodulator, 12:23243 (R;NO)

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Energy Conservation
City of Heyburn conservation plan, 12:22798 (R;US)

COMPACT IGNITION TOKAMAK

A Tokamak proposed as a next-step after TFTR, i.e., for extensive ignited-core studies.

Neutron Transport
One- and two-dimensional radiation analysis of the Compact Ignition Tokamak, 12:24280 (R;US)

Shielding
One- and two-dimensional radiation analysis of the Compact Ignition Tokamak, 12:24280 (R;US)

COMPACT TORUS

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Magnetic Fields
Rotating magnetic field technique of driving current and its application in the Rotamak, 12:24216 (RA;FR)

Rotation
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See also SUPERCONDUCTING COMPOSITES

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Evaluation of wear rates and mechanisms of titanium diboride-graphite composite materials proposed for use as cathodes in Hall-Heroult cells, 12:22956 (R;US)

COMPOUNDS (ORGANIC)

See ORGANIC COMPOUNDS

COMPUTED TOMOGRAPHY

See COMPUTERIZED TOMOGRAPHY

COMPUTER CODES

Computer codes are indexed by their initial letter and CODES, e.g., A CODES. If the code name begins with a number the code is indexed to NUMBER CODES.

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B CODES
C CODES
D CODES
F CODES
M CODES
N CODES
S CODES

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See COMPUTER CODES

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Computer Graphics
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Parallel Processing
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Performance
Secondary containment building performance in severe accidents, 12:22563 (RA;US)

COMPUTERIZED TOMOGRAPHY
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Security
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Safeguards and security progress report, January-December 1985, 12:22338 (R;US)
Training
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CONCENTRATIONS (RADIONUCLIDES)
See RADIOACTIVITY

CONCENTRATOR SOLAR CELLS
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Fresnel Lens
Development of a holographic beamsplitter for use with a conventional Fresnel lens, 12:22371 (R;US)

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Simplified model for concrete at low confining pressures, 12:22583 (RA;US)
Fluid-Structure Interactions
Further development of KAVERN and code development on gas generation from the containment basement during concrete decomposition, 12:22522 (R;DE;In German)
Mathematical Models
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CONTACTS (ELECTRIC)
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REACTOR VESSELS
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Crack propagation in high strain regions of a steel containment, 12:22591 (RA;US)
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De Haas-Van Alphen Effect
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Cosmic ray acceleration by collisionless shocks, 12:23749 (RA;FR)
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623	NTIS, PC A05; 3		DE87007041	STD -70	12:22253
632	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007042	STD -70	12:22254
633	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007357	STD -70	12:22937
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38790	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007154	MN -95d	12:22706
39180	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006907	MN -98B	12:22192
39209	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006742	MN -41	12:23423
39293	NTIS, PC A02; 3		DE87006457	MN -38	12:22983
39310	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006915	MN -48	12:23535
39314	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006916	MN -70B	12:22255
39350	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006744	MN -98B	12:22193
39351	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007642	MN -41	12:23688
39371	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006740	MN -90	12:22167
39372	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006739	MN -90a	12:22084
39373	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006465	MN -34A	12:23791
39422	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006904	MN -25	12:22922
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39315	NTIS, PC A02 - GPO		DE87006469	MN -70B	12:22256
39319	NTIS, PC A02 - GPO; 3		DE87006470	MN -70B	12:22257
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86-05	NTIS (US Sales Only), PC A02/MF A01		DE87751195	MN -34D	12:23849
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888	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006819	MN -97	12:23715
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82-SGN-1012-GEO	*See* EUR-9866-Vol.5		DE87751124	MN -70	12:22268
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8509	NTIS (US Sales Only), PC A02/MF A01		DE87750984	MN -78	12:22450
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86/ 47	*See* ORNL/TM-10232	E 1.99:	DE87005277	MN -38	12:22673
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116/ D	NTIS (US Sales Only), PC A08/MF A01		DE87701495	MN -48	12:23483

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CONF-8010386-	(IAEA/RCA project review meeting, Seoul, Korea, 13-17 Oct 1980)			
1	*See* PPA-CR-4	DE87701455	MN -34B	12:23418
CONF-811058-	(International Flame Research Association meeting, Chicago, IL, USA, 5-7 Oct 1981)			
2	*See* DOE/METC-86/4068	E 1.99: DE86006593	MN -90c	12:22796
CONF-8205317-	(Radiation safety of nuclear power plants operation conference, Vil'nyus, USSR, 1 May 1982, 1 May 1982)			
Vol.1	*See* INIS-mf-10580-Vol.1	DE87780112	MN -80	12:22536
Vol.2	*See* INIS-mf-10580-Vol.2	DE87780113	MN -80	12:22552
CONF-8310441-	(2. research co-ordination meeting on in vitro technology for mutation breeding, Vienna, Austria, 31 Oct-4 Nov 1983)			
Summ.	*See* IAEA-TECDOC-392	DE87701617	MN -48	12:23620
CONF-831138-	(International school of radiation damage and protection: biological effects and dosimetry of non-ionizing radiation, Erice, Italy, 15-25 Nov 1983)			
	See ISS-L-84/7	DE87900284	MN -84	12:23644
CONF-840311-	(4. international symposium on heating in toroidal plasmas, Rome, Italy, 21-28 Mar 1984)			
Exc.	*See* LRP-252/84	DE87900202	MN -20	12:24252
CONF-840616-	(Joint conference of the 6. international conference on plasma physics and on the 6. international congress on plasma waves and plasma instabilities, Lausanne, Switzerland, 27 Jun-3 Jul 1984)			
Vol.1	*See* EUR-9708-Vol.1	DE87751134	MN -20a	12:24214
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CONF-840873-	(US summer school on high energy particle accelerators, Batavia, IL, USA, 13-24 Aug 1984)			
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CONF-8409161-	(5. symposium on neutron dosimetry, Munich, F.R. Germany, 17-21 Sep 1984)			
Vol.1	*See* EUR-9762-Vol.1	DE87751063	MN -41	12:23289
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CONF-8409225-	(Colloquium on heavy ion collisions: from collective motions to quarks, Cargese, France, 2-15 Sep 1984)			
4-Prepr.	*See* NORDITA-84/46-Prepr.	DE87751240	MN -34D	12:24039
CONF-8409389-	(Advisory group meeting on mathematical models for interpretation of tracer data in groundwater hydrology, Vienna, Austria, 17-21 Sep 1984)			
	See IAEA-TECDOC-381	DE87701515	MN -11	12:23499
CONF-8504292-	(6. Czechoslovak biophysical congress with international participation, Bratislava, Czechoslovakia, 10-12 Apr 1985)			
Exc.	*See* INIS-mf-10576	DE87701460	MN -23	12:23640
CONF-8505330-	(11. annual meeting of the Spanish Physical Society, Barcelona, Spain, 28-30 May 1985)			
1	*See* FRADOC-9-7	DE87751006	MN -80	12:22490
CONF-8505346-	(Seminar on worker in nuclear activities, Rio de Janeiro, Brazil, 1 May 1985, 1 May 1985)			
1	*See* INIS-BR-583	DE87701622	MN -2	12:23639
CONF-850611-	(32. annual meeting of the Society of Nuclear Medicine, Houston, TX, USA, 2-5 Jun 1985)			
	J. Nucl. Med., 26: No. 5, 106(May 1985)			12:23611
CONF-850679-	(18. American Society for Testing and Materials symposium, Boulder, CO, USA, 1 Jun 1985)			
4	*See* UCRL-91409	E 1.99: DE87007090	MN -25	12:22869
CONF-8506335-	(Scientific and technical conference on the occasion of the 30th anniversary of the Czechoslovak Nuclear Research Institute, Rez, Czechoslovakia, 6-7 Jun 1985)			
Pt.4	*See* INIS-mf-10574	DE87701448	MN -4	12:23154
CONF-850706-	(8. international symposium on detonation, Albuquerque, NM, USA, 15-19 Jul 1985)			
34	*See* UCRL-91483	DE87007100	MN -45	12:23395
CONF-850759-	(10. high pressure conference on research in high pressure science and technology, Amsterdam, Netherlands, 8-11 Jul 1985)			
17	*See* UCRL-92887	E 1.99: DE87006690	MN -34	12:22871
I8	*See* UCRL-92885	E 1.99: DE87006691	MN -25	12:22870
CONF-850771-	(SLAC summer school on the physics of high energy particle accelerators, Stanford, CA, USA, 15-26 Jul 1985)			
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CONF-850805-	(International symposium on nuclear techniques and in-vitro culture for plant improvement, Vienna, Austria, 19-23 Aug 1985)			
Summ.	*See* IAEA-TECDOC-392	DE87701617	MN -48	12:23620
CONF-8508223-	(8. conference of Czechoslovak physicists, Bratislava, Czechoslovakia, 26-30 Aug 1985)			
Pt.1-Vol.1	*See* INIS-mf-10589	DE87701626	MN -34D	12:23820
CONF-850944-	(Muskoka conference: international symposium on acidic precipitation, Toronto, Ontario, Canada, 15-20 Sep 1985)			
	Water, Air, Soil Pollut., 30: No. 3-4, 857-866(Oct 1986)			12:23448
	Water, Air, Soil Pollut., 30: No. 3-4, 885-896(Oct 1986)			12:23449
	Water, Air, Soil Pollut., 30: No. 3-4, 815-824(Oct 1986)			12:23450
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	Water, Air, Soil Pollut., 30: No. 3-4, 639-648(Oct 1986)			12:23523
CONF-8509125-	(Conference on separation of ionic solutes, Smolenice, Czechoslovakia, 2-6 Sep 1985)			
Exc.-Absts.	*See* INIS-mf-10577	DE87701572	MN -4	12:23021
CONF-8509147-	(ACTINIDES '85, Aix-en-Provence, France, 1-6 Sep 1985)			
	J. Less-Common Met., 121: 121(Jul 1986)			12:22888
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CONF-8509369-	(1. Brazilian congress on mining, Brasilia, Brazil, 23-27 Sep 1985)			
1	*See* INIS-BR-577	DE87701446	MN -4	12:23000
CONF-8509372-	(2. seminar on software development in nuclear energy research, Tokai, Japan, 18-19 Sep 1985)			
	See JAERI-M-86-009	DE87780110	MN -78	12:22446
CONF-8509375-	(6. Brazilian seminar of non-destructive tests, Belo Horizonte, Brazil, 1 Sep 1985, 1 Sep 1985)			
1	*See* INIS-BR-579	DE87701618	MN -37	12:23351
2	*See* INIS-BR-580	DE87701619	MN -23	12:22347
3	*See* INIS-BR-581	DE87701620	MN -25	12:23231
4	*See* INIS-BR-582	DE87701621	MN -25	12:23232
CONF-8510249-	(19. international symposium on remote sensing of environment, Ann Arbor, MI, USA, 21-25 Oct 1985)			
Vol.1	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99: DE87006268	MN -11	12:23467
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CONF-8510272-	(IAEA consultants' meeting on nuclear reference materials needs and availability, Antwerp, Belgium, 8-11 Oct 1985)			
Summ.	*See* IAEA-RL-127	DE87701514	MN -4	12:22997
CONF-8510403-	(Symposium on mining Pribram in science and technology, Pribram, Czechoslovakia, 14-18 Oct 1985)			
Exc.	*See* INIS-mf-10575	DE87701445	MN -4	12:23011
CONF-851194-	(4. nuclear techniques of analysis conference, Lucas Heights, Australia, 6-7 Nov 1985)			
	See INIS-mf-10581	DE87701623	MN -4	12:23034
CONF-8511136-	(Direct liquefaction contractors conference, Pittsburgh, PA, USA, 19-21 Nov 1985)			
	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE87006353	MN -90d	12:22088
CONF-860162-	(Workshop on radiation damage to wire chambers, Berkeley, CA, USA, 16-17 Jan 1986)			
7	*See* MPI-PAE/Exp.El.-160	DE87751228	MN -37	12:23366
CONF-860209-	(27. conference of the Association for Development of Computer Based Instructional Systems, New Orleans, LA, USA, 3-6 Feb 1986)			
2	*See* HEDL-SA-3459-FP	E 1.99: DE87005463	MN -32	12:24333
CONF-860210-	(IEEE Power Engineering Society winter meeting, New York, NY, USA, 2-7 Feb 1986)			
4	*See* LBL-20765	DE87006145	MN -48	12:23716
CONF-860272-	(Wire chamber conference, Vienna, Austria, 25-28 Feb 1986)			
	Nucl. Instrum. Methods Phys. Res., Sect. A., 252: No. 2/3, 180-187(1 Dec 1986)			12:23379
	Nucl. Instrum. Methods Phys. Res., Sect. A., 252: No. 2/3, 251-254(1 Dec 1986)			12:23380

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	Nucl. Instrum. Methods Phys. Res., Sect. A., 252: No. 2/3, 471-477(1 Dec 1986)			12:23382
CONF-860316-	(Topical meeting on short wave length coherent radiation, Monterey, CA, USA, 24-27 Mar 1986)			
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004729	MN -34A	12:23792
CONF-860451-	(22. annual meeting of the National Council on Radiation Protection and Measurements, Washington, DC, USA, 2-3 Apr 1986)			
2	*See* LBL-22321	E 1.99: DE87006946	MN -48	12:23717
CONF-860459-	(Sherwood theory meeting, New York, NY, USA, 13-17 Apr 1986)			
1-Vugraphs	*See* DOE/ER/52127-11	DE87006230	MN -20	12:24195
CONF-8604302-	(SEUGI '86: conference of European SAS users, Brighton, UK, 15-18 Apr 1986)			
1	*See* ENEA-RT-TIB-86/18	DE87900154	MN -32	12:24332
CONF-8604306-	(Elmau international symposium, Elmau, F.R. Germany, 20-26 Apr 1986)			
1	*See* UCRL-96017	E 1.99: DE87006688	MN -48	12:23618
CONF-8605182-	(7. Vanderbilt high energy physics conference, Nashville, TN, USA, 15-17 May 1986)			
3	*See* DOE/ER/40272-23	E 1.99: DE87005677	MN -34D	12:23915
CONF-8605196-	(EEC hot laboratories meeting, Brasimone, Italy, 21-23 May 1986)			
2	*See* CEA-CONF-8509	DE87750984	MN -78	12:22450
CONF-860605-	(13. international symposium on the effects of radiation on materials, Seattle, WA, USA, 23-25 Jun 1986)			
34	*See* RISO-M-2612	DE87750670	MN -25	12:22864
CONF-860681-	(6. international conference on finite elements in water, Lisbon, Portugal, 1 Jun 1986)			
3	*See* RHO-BW-SA-586-P	E 1.99: DE87007170	MN -70	12:23724
CONF-8606134-	(4. international conference on muon spin rotation, relaxation and resonance, Uppsala, Sweden, 1 Jun 1986)			
10	*See* BNL-39422	E 1.99: DE87006904	MN -25	12:22922
CONF-8606161-	(2. annual DOE contractors meeting on health and environmental effects of complex chemical mixtures, Delavan, WI, USA, 16-18 Jun 1986)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004968	MN -48	12:23689
CONF-8606183-	(NATO international advanced course on physics of strong fields, Maratea, Italy, 1-14 Jun 1986)			
8-Prepr.	*See* GSI-86-33-Prepr.	DE87751185	MN -34A	12:23802
CONF-8606215-	(Summer study on the physics of the superconducting super collider, Snowmass, CO, USA, 23 Jun-11 Jul 1986)			
38	*See* DOE/ER/40272-26	DE87006235	MN -34D	12:23854
39	*See* FNAL/C-86/167	E 1.99: DE87006282	MN -34D	12:23857
CONF-8606226-	(Symposium on topological and geometrical methods in field theory, Espoo, Finland, 8-14 Jun 1986)			
2	*See* NBI-HE-86-34	DE87751350	MN -34D	12:23912
CONF-8606233-	(2. nobel symposium on elementary particle physics, Marstrand, Sweden, 2-7 Jun 1986)			
3	*See* NBI-HE-86-28	DE87751352	MN -34D	12:23923
CONF-8606235-	(2. world conference on neutron radiography, Paris, France, 16-20 Jun 1986)			
1	*See* RISO-M-2579	DE87750665	MN -25	12:23237
2	*See* RISO-M-2578	DE87750666	MN -25	12:23236
3	*See* RISO-M-2577	DE87750667	MN -25	12:23235
4	*See* RISO-M-2576	DE87750668	MN -25	12:23234
5	*See* RISO-M-2575	DE87750669	MN -25	12:23233
CONF-8606256-	(1. joint congress of the South African Biochemical Society, South African Genetics Society and the South African Society for Microbiology, Johannesburg, South Africa, 29 Jun-4 Jul 1986)			
	See INIS-mf-10578	DE87780106	MN -48	12:23542
CONF-8606277-	(10. annual geothermal conference and workshop, Portland, OR, USA, 24-26 Jun 1986)			
	See EPRI-AP-5059-SR	TI87920265	ND -66	12:22394
CONF-8606278-	(Meeting with states on the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985, Bethesda, MD, USA, 24-25 Jun 1986)			
	See NUREG/CP-0085	TI87900553	MN -70B	12:22301
CONF-8606285-	(Information meeting on the Chernobyl reactor accident and the resulting radioactive exposure in the Federal Republic of Germany, Bonn, F.R. Germany, 4 Jun 1986)			
1	*See* INIS-mf-10329	DE87751199	MN -80	12:22523
CONF-860735-	(Adriatico research conference on environmental physics: the physics of aerosols, Miramare, Trieste, Italy, 21-25 Jul 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004990	MN -11	12:23451

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CONF-860736-	(SLAC summer institute on particle physics, Stanford, CA, USA, 29 Jul-9 Aug 1986)				
9	*See* SLAC-PUB-4168		DE87005931	MN -34D	12:23925
CONF-860766-	(Nato advanced research workshop on super field theories, Vancouver, Canada, 25-30 Jul 1986)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004578	MN -34D	12:23914
CONF-8607101-	(18. europhysics conference of the European Group for Atomic Spectroscopy (EGAS-18), Marburg, F.R. Germany, 8-11 Jul 1986)				
1-Prepr.	*See* GSI-86-42-Prepr.		DE87751183	MN -28	12:23269
2-Prepr.	*See* GSI-86-25-Prepr.		DE87751184	MN -34A	12:23801
CONF-8607118-	(4. ICENES conference, Madrid, Spain, 7 Jul 1986)				
1	*See* DOE/ER/13064-5	E 1.99:	DE87006286	MN -20	12:24282
CONF-860802-	(International nuclear physics conference, Harrogate, UK, 25-30 Aug 1986)				
12-Summ.	*See* CEA-CONF-8552		DE87751065	MN -34C	12:23981
CONF-860818-	(American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings, Santa Cruz, CA, USA, 17-23 Aug 1986)				
17	*See* LBL-22688		DE87006936	MN -95d	12:22766
CONF-860826-	(National meeting of the American Institute of Chemical Engineers, Boston, MA, USA, 24-27 Aug 1986)				
12	NTIS, PC A02; 3		DE87006965	MN -95e	12:22793
CONF-860829-	(Annual joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society, Albuquerque, NM, USA, 10-15 Aug 1986)				
40	*See* RHO-BW-SA-565-P	E 1.99:	DE87007395	MN -70	12:23723
CONF-860832-	(11. international conference on few-body systems in particle and nuclear physics, Tokyo, Japan, 24-30 Aug 1986)				
12	*See* DOE/ER/05126-300	E 1.99:	DE87002265	MN -34C	12:23987
CONF-860833-	(10. international conference on atomic physics, Tokyo, Japan, 25-29 Aug 1986)				
4-Prepr.	*See* GSI-86-34-Prepr.		DE87751229	MN -34A	12:23803
CONF-860879-	(International conference on martensitic transformations (ICOMAT-86), Nara, Japan, 26-30 Aug 1986)				
5	*See* UCRL-93392	E 1.99:	DE87005054	MN -25	12:22872
CONF-860880-	(30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986)				
46	*See* UCRL-95706	E 1.99:	DE87005946	MN -38	12:23218
48	*See* DOE/DP/40200-35		DE87005918	MN -21	12:23214
CONF-8608133-	(Conference on radiation and health hazards: Chernobyl in perspective, Stockholm, Sweden, 28 Aug 1986)				
	See INIS-mf-10585		DE87750699	MN -41	12:22553
CONF-8608158-	(Liquid and amorphous metals 6, Garmisch, Partenkirchen, F.R. Germany, 25-29 Aug 1986)				
1	*See* UCRL-95831	E 1.99:	DE87003816	MN -4	12:22874
CONF-8608163-	(Structure, coherence, and chaos in dynamical systems conference, Lyngby, Denmark, 1 Aug 1986)				
1	*See* LA-UR-87-352	E 1.99:	DE87006068	MN -34	12:24341
CONF-8608165-	(SAS users group international conference: SUGI II, Cary, NC, USA, 18-21 Aug 1986)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006370	MN -41	12:23617
CONF-860911-	(192. American Chemical Society national meeting, Anaheim, CA, USA, 7-12 Sep 1986)				
	Am. Chem. Soc., Div. Pet. Chem., Gen. Pap., Prepr., 31: No. 3, 752(Sep 1986)				12:22139
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	Am. Chem. Soc., Div. Pet. Chem., Gen. Pap., Prepr., 31: No. 3, 761(Sep 1986)				12:22152
CONF-860977-	(Antiproton '86: European symposium on nucleon-antinucleon interactions, Thessalonika, Greece, 1-5 Sep 1986)				
2	*See* DOE/ER/40033-123		DE87005904	MN -34D	12:23827
CONF-860983-	(Oceans '86, Washington, DC, USA, 23-25 Sep 1986)				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005159	MN -4	12:22984
CONF-860990-	(8. annual participants' information meeting of the DOE Low-Level Waste Management Program, Denver, CO, USA, 22-26 Sep 1986)				
15	*See* BNL-39314	E 1.99:	DE87006916	MN -70B	12:22255
CONF-8609132-	(Resonance ionization spectroscopy and its application, Swansea, UK, 7-12 Sep 1986)				
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004975	MN -4	12:23093
CONF-8609159-	(International school-seminar on heavy ion physics, Dubna, USSR, 23-30 Sep 1986)				
4-Prepr.	*See* GSI-86-43-Prepr.		DE87751179	MN -28	12:23261
CONF-8609219-	(Brasov international summer school: symmetrics and semiclassical features of nuclear dynamics, Poiana Brasov, Romania, 1-13 Sep 1986)				
1	*See* KFK-4158		DE87751232	MN -34C	12:23946

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CONF-8609244-	(Dynamics of molecular photofragmentation conference, University of Bristol, UK, 15-17 Sep 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004671	MN -34A	12:23794
CONF-8609252-	(Conference on the physics of multiple charged ions, Groningen, Netherlands, 17-19 Sep 1986)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87005810	MN -34A	12:23795
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005911	MN -34A	12:23796
CONF-8609257-	(IAEA advisory group meeting on atomic data for fusion plasma modelling, Vienna, Austria, 18-20 Sep 1986)			
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87004420	MN -34A	12:23797
CONF-8609264-	(Workshop on global seismic monitoring, Canberra, Australia, 23-25 Sep 1986)			
1-Rev.2	*See* UCRL-95242-Rev.2	E 1.99: DE87007094	MN -11	12:23407
CONF-861002-	(Automotive technology development contractors' coordination meeting, Dearborn, MI, USA, 27-30 Oct 1986)			
6	NTIS, PC A02; 3	DE87007007	MN -96	12:22811
Summs.	NTIS, PC A22/MF A01; 1	DE87001335	MN -96	12:22805
CONF-861007-	(Nuclear science and nuclear power systems symposium, Washington, DC, USA, 29-31 Oct 1986)			
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 389-395(Feb 1987)			12:23086
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 232-235(Feb 1987)			12:23282
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 253-257(Feb 1987)			12:23283
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 266-270(Feb 1987)			12:23372
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 142-150(Feb 1987)			12:23373
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 175-178(Feb 1987)			12:23374
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 213-221(Feb 1987)			12:23375
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 245-249(Feb 1987)			12:23376
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 250-252(Feb 1987)			12:23377
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 151-156(Feb 1987)			12:24355
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 162-165(Feb 1987)			12:24356
	IEEE Trans. Nucl. Sci., NS-34: No. 1, 166-169(Feb 1987)			12:24357
CONF-861012-	(7. international symposium on alcohol fuels, Paris, France, 20-23 Oct 1986)			
2	NTIS, PC A02; 3	DE87004738	MN -96	12:22812
CONF-861019-	(10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society, Baltimore, MD, USA, 27-31 Oct 1986)			
26	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004864	MN -25	12:22923
CONF-861038-	(OSA/APS international laser science conference, Seattle, WA, USA, 20-24 Oct 1986)			
9	*See* ANL-HEP-CP-86-132	E 1.99: DE87004963	MN -38	12:23213
CONF-861039-	(Instrument Society of America international conference and exhibit, Houston, TX, USA, 13-16 Oct 1986)			
2	*See* Y/DW-638	E 1.99: DE87005913	MN -37	12:23388
CONF-8610122-	(8. international electric vehicle symposium, Washington, DC, USA, 20-23 Oct 1986)			
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004818	MN -96	12:22807
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004822	MN -96	12:22641
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004941	MN -96	12:22642
15	NTIS, PC A02; 3	DE87004931	MN -96	12:22643
CONF-8610183-	(LAMPF users group meeting, Los Alamos, NM, USA, 1 Oct 1986)			
2	*See* LA-UR-87-356	E 1.99: DE87006050	MN -34D	12:23811
CONF-8610210-	(23. joint Army Navy NASA Air Force combustion meeting (JANNAF), Hampton, VA, USA, 20-24 Oct 1986)			
1	*See* UCRL-94769	E 1.99: DE87001357	MN -38	12:23186
CONF-8610228-	(Atmospheric and meteorological effects on low-frequency, long-range sound propagation, Albuquerque, NM, USA, 27 Oct 1986, 27 Oct 1986)			
1	*See* LA-UR-87-258	E 1.99: DE87005095	MN -11	12:24177
CONF-8610257-	(Santa Fe graph reduction workshop, Santa Fe, NM, USA, 1 Oct 1986)			
1	*See* LA-UR-87-673	E 1.99: DE87006066	MN -32	12:24342
CONF-8610258-	(International school on electronic band structure, Kanpur, India, 20 Oct-8 Nov 1986)			
1	*See* LBL-22608	E 1.99: DE87007166	MN -25	12:24114

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CONF-861102-	(American Nuclear Society and Atomic Industrial Forum joint meeting, Washington, DC, USA, 16-21 Nov 1986)			
	Trans. Am. Nucl. Soc., 53: 291-292(1986)			12:22331
	Trans. Am. Nucl. Soc., 53: 296-297(1986)			12:22332
	Trans. Am. Nucl. Soc., 53: 298-300(1986)			12:22333
	Trans. Am. Nucl. Soc., 53: 192(1986)			12:22341
	Trans. Am. Nucl. Soc., 53: 193-194(1986)			12:22342
	Trans. Am. Nucl. Soc., 53: 194-195(1986)			12:22343
	Trans. Am. Nucl. Soc., 53: 195-196(1986)			12:22344
	Trans. Am. Nucl. Soc., 53: 183-184(1986)			12:22350
	Trans. Am. Nucl. Soc., 53: 239-241(1986)			12:22449
	Trans. Am. Nucl. Soc., 53: 260-261(1986)			12:22460
	Trans. Am. Nucl. Soc., 53: 476-477(1986)			12:22462
	Trans. Am. Nucl. Soc., 53: 215-216(1986)			12:22474
	Trans. Am. Nucl. Soc., 53: 14(1986)			12:22478
	Trans. Am. Nucl. Soc., 53: 230-231(1986)			12:22485
	Trans. Am. Nucl. Soc., 53: 269-270(1986)			12:22486
	Trans. Am. Nucl. Soc., 53: 469-470(1986)			12:22487
	Trans. Am. Nucl. Soc., 53: 470-471(1986)			12:22488
	Trans. Am. Nucl. Soc., 53: 142-143(1986)			12:22608
	Trans. Am. Nucl. Soc., 53: 271-272(1986)			12:22611
	Trans. Am. Nucl. Soc., 53: 182-183(1986)			12:23238
	Trans. Am. Nucl. Soc., 53: 25-26(1986)			12:23607
	Trans. Am. Nucl. Soc., 53: 30-31(1986)			12:23608
	Trans. Am. Nucl. Soc., 53: 34-35(1986)			12:23609
	Trans. Am. Nucl. Soc., 53: 36-37(1986)			12:23610
	Trans. Am. Nucl. Soc., 53: 475-476(1986)			12:23986
	Trans. Am. Nucl. Soc., 53: 278-280(1986)			12:24059
	Trans. Am. Nucl. Soc., 53: 283-285(1986)			12:24060
	Trans. Am. Nucl. Soc., 53: 37-38(1986)			12:24096
	Trans. Am. Nucl. Soc., 53: 242-243(1986)			12:24276
	Trans. Am. Nucl. Soc., 53: 243-244(1986)			12:24361
37	*See* HEDL-SA-3551-FP	E 1.99: DE87005461	MN -79b	12:22519
CONF-861106-	(IAEA international conference on plasma physics and controlled nuclear fusion research, Kyoto, Japan, 12-19 Nov 1986)			
23-Trans.	*See* IAEA-CN-47/F-IV-4	E 1.99: DE87006664	MN -20f	12:24243
CONF-861146-	(AIChE winter annual meeting, Miami, FL, USA, 2-7 Nov 1986)			
15	*See* PNL-SA-14369	DE87005607	MN -61D	12:22356
CONF-861158-	(8. North American International Association of Energy Economists conference: changing world energy economy, Cambridge, MA, USA, 19-21 Nov 1986)			
4	*See* PNL-SA-13763	E 1.99: DE87006438	MN -98	12:22660
5	NTIS, PC A02; 3	DE87006961	MN -98F	12:22654
6	NTIS, PC A02; 3	DE87006979	MN -90h	12:22655
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006980	MN -98	12:22658
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006963	MN -13	12:23424
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006962	MN -11	12:22663
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006982	MN -98	12:22659
CONF-861185-	(Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting, Gatlinburg, TN, USA, 3-6 Nov 1986)			
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006970	MN -83	12:22924
CONF-8611103-	(20. symposium of North Eastern Accelerator Personnel, Notre Dame, IN, USA, 3-6 Nov 1986)			
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004867	MN -28	12:23267
CONF-8611107-	(10. GRS expert's meeting on results of new safety analyses, Koeln, F.R. Germany, 12-13 Nov 1986)			
1	*See* INIS-mf-10332	DE87751200	MN -80	12:22524
2	*See* INIS-mf-10333	DE87751201	MN -80	12:22525
3	*See* INIS-mf-10334	DE87751202	MN -80	12:22526
4	*See* INIS-mf-10336	DE87751203	MN -11	12:23457
5	*See* INIS-mf-10247	DE87751204	MN -80	12:22521
CONF-8611117-	(Annual meeting of the Society for Risk Analysis, Boston, MA, USA, 9-12 Nov 1986)			
4	*See* UCRL-96032	E 1.99: DE87006825	MN -32	12:24382
CONF-8611124-	(3. international workshop on cross sections for fusion and other applications, College Station, TX, USA, 6-8 Nov 1986)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007375	MN -34A	12:23798
CONF-8611131-	(NASA workshop on atomic oxygen effects, Pasadena, CA, USA, 10-11 Nov 1986)			
2	*See* BNL-39373	E 1.99: DE87006465	MN -34A	12:23791
CONF-8611136-	(DOE/Industry Research and Development Sensor Working Group meeting, Chicago, IL, USA, 14 Nov 1986, 14 Nov 1986)			
	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87006159	STD -95f	12:22787
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)			
75	*See* SAND-86-1374C	E 1.99: DE87002049	MN -25	12:22957
77	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006616	MN -25	12:22938

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79	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006628	MN -25	12:22939
80	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006613	MN -25	12:22821
81	*See* UCRL-94664	E 1.99: DE87006687	MN -11	12:22314
82	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006971	MN -70	12:22985
83	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006976	MN -25	12:22822
84	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006975	MN -70	12:22940
85	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006972	MN -25	12:22823
86	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004831	MN -25	12:22986
87	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006974	MN -25	12:22824
88	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006973	MN -25	12:22941
89	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006983	MN -25	12:22925
90	*See* UCRL-94500	E 1.99: DE87007098	MN -25	12:22873
CONF-861240-	(3. national conference on high power microwave technology for defense applications, Albuquerque, NM, USA, 1-5 Dec 1986)			
13	*See* UCRL-95613	E 1.99: DE87006693	MN -38	12:23205
CONF-861247-	(5. simposio Chiceno de Fisica, Santiago, Chile, 18-20 Dec 1986)			
2	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87007044	MN -34A	12:24098
CONF-861265-	(Intelligent autonomous systems international conference, Amsterdam, Netherlands, 8-11 Dec 1986)			
1	NTIS MF A01 (GPO Dep.)	E 1.99: DE87003657	MN -38	12:23192
CONF-861268-	(Symposium on acid rain: the relationship between sources and receptors, Arlington, VA, USA, 3-4 Dec 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007008	MN -11	12:23425
CONF-861269-	(5. US-USSR symposium on comprehensive analysis of the environment, Washington, DC, USA, 10-13 Dec 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006625	MN -11	12:23426
CONF-861270-	(NJE workshop on NJE, Gif-sur-Yvette, France, 10-11 Dec 1986)			
1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87007033	MN -32	12:24329
CONF-870102-	(4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987)			
10	*See* DOE/NASA/16310-2	E 1.99: DE87006776	STD -25	12:22829
13	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87007032	MN -80	12:22476
CONF-870103-	(2. international conference on constitutive laws for engineering materials, Tucson, AZ, USA, 5-10 Jan 1987)			
6	*See* LA-UR-87-383	E 1.99: DE87006052	MN -38	12:23241
CONF-870128-	(6. symposium on meteorological observations and instrumentation, New Orleans, LA, USA, 12-16 Jan 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007001	MN -11	12:23411
CONF-870132-	(LASE-13: pulse power for lasers conference, Los Angeles, CA, USA, 11-16 Jan 1987)			
4	*See* BNL-39293	DE87006457	MN -38	12:22983
CONF-870142-	(5. international conference on valence fluctuations, Bangalore, India, 5-9 Jan 1987)			
7	*See* LA-UR-87-389	E 1.99: DE87006053	MN -25	12:24142
8	*See* LA-UR-87-455	E 1.99: DE87006057	MN -25	12:22857
9	*See* LA-UR-87-310	E 1.99: DE87006071	MN -25	12:22855
10	*See* LA-UR-87-438	E 1.99: DE87006055	MN -25	12:22856
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006988	MN -25	12:22825
CONF-870151-	(Irvine conference on non-perturbative methods in field theory, Laguna Beach, CA, USA, 7 Jan 1987, 7 Jan 1987)			
1	*See* LA-UR-87-634	E 1.99: DE87006061	MN -34D	12:23919
CONF-870152-	(Workshop on opportunities for atomic physics using slow highly-charged ions, Argonne, IL, USA, 12-13 Jan 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005814	MN -34A	12:23793
CONF-870155-	(10. Werner Bradt workshop on penetration phenomena: dynamic actions of energetic probes with condensed matter, Alicante, Spain, 7-10 Jan 1987)			
1	*See* UCRL-95038	E 1.99: DE87006241	MN -34A	12:24118
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006619	MN -34A	12:24099
CONF-870156-	(Workshop on hydrocode application in ocean environment, Marina del Ray, CA, USA, 14 Jan 1987)			
1	*See* UCRL-95996	E 1.99: DE87005967	MN -11	12:23404
CONF-870158-	(Workshop on proton and neutral meson physics at intermediate energies, Los Alamos, NM, USA, 8-10 Jan 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006211	MN -34C	12:23286
CONF-870159-	(International conference on physics of chaos and systems far from equilibrium, Monterey, CA, USA, 11-14 Jan 1987)			
1	*See* UCRL-96070	E 1.99: DE87006823	MN -32	12:24354
CONF-870160-	(American Society for Testing and Materials symposium, Tampa, FL, USA, 19-23 Jan 1987)			
1	*See* UCRL-95101	E 1.99: DE87006452	MN -41	12:23204

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CONF-870162-	(3. national space symposium of the United States Space Foundation, Colorado Springs, CO, USA, 20-23 Jan 1987)			
1	*See* UCRL-96258	E 1.99: DE87006467	MN -13	12:24317
CONF-870163-	(DOE/CEC workshop on mechanisms of radiation interaction with DNA, San Diego, CA, USA, 21 Jan 1987)			
1	*See* PNL-SA-14591	E 1.99: DE87004922	MN -48	12:23667
CONF-870203-	(Institute of Electrical and Electronic Engineers/ Power Engineering Society winter meeting, New Orleans, LA, USA, 1-6 Feb 1987)			
4	*See* SAND-87-0445C	DE87006135	MN -45	12:23400
CONF-870212-	(Annual meeting and exhibition of the Society of Mining Engineers, Denver, CO, USA, 24-27 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006363	MN -13	12:24307
2	*See* SAND-86-7020C	E 1.99: DE87007081	MN -70	12:22312
CONF-870224-	(2. topical meeting on microphysics of surfaces, beams and adsorbates, Santa Fe, NM, USA, 16-18 Feb 1987)			
2	*See* SAND-87-0358C	E 1.99: DE87006132	MN -34A	12:24117
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006989	MN -34A	12:24100
CONF-870245-	(Oak Ridge model conference, Oak Ridge, TN, USA, 3-5 Feb 1987)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006607	MN -70B	12:22258
CONF-870249-	(Computing high energy physics, Pacific Grove, CA, USA, 2-6 Feb 1987)			
1-Extd.Ver.	*See* SLAC-PUB-4148-Extd.Ver.	DE87005972	MN -32	12:23821
CONF-870252-	(Solving ground water problems with models conference, Denver, CO, USA, 10-12 Feb 1987)			
7	*See* DP-MS-86-112	DE87006272	MN -11	12:23474
CONF-870254-	(3. international conference on ultrastructure processing of ceramics, glasses, and composites, San Diego, CA, USA, 23-27 Feb 1987)			
1	NTIS, PC A02; 3	DE87005710	MN -4	12:23092
CONF-870255-	(18. southeastern international conference on combinatorics: graph theory computing, Boca Raton, FL, USA, 23-27 Feb 1987)			
1	*See* SAND-87-0256C	DE87005850	MN -32	12:24349
CONF-870259-	(23. congress of the Society of Theoretical and Applied Limology, Hamilton, New Zealand, 8-14 Feb 1987)			
1	*See* PNL-SA-14439	E 1.99: DE87006440	MN -11	12:23507
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005337	MN -11	12:23496
3	NTIS, PC A03/MF A01	DE87006205	MN -11	12:23497
CONF-870261-	(3. international conference on data engineering, Los Angeles, CA, USA, 2-6 Feb 1987)			
1	*See* LBL-21747	DE87006146	MN -32	12:24380
2	*See* LBL-22848	E 1.99: DE87006932	MN -32	12:24381
CONF-870301-	(International topical meeting on remote systems and robotics in hostile environments, Pasco, WA, USA, 29 Mar-2 Apr 1987)			
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004066	MN -38	12:23193
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)			
1	*See* LA-UR-87-663	DE87006064	MN -28	12:23280
2	*See* LA-UR-87-297	DE87006074	MN -28	12:23270
3	*See* LA-UR-87-354	E 1.99: DE87006049	MN -28	12:23271
4	*See* LA-UR-87-660	DE87006063	MN -28	12:23272
5	*See* LA-UR-87-669	DE87006065	MN -28	12:23281
8	*See* SAND-87-0635C	E 1.99: DE87006893	MN -21	12:24300
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)			
2	*See* SAND-86-2198C	E 1.99: DE86016109	MN -70	12:22250
31	*See* PNL-SA-14409	E 1.99: DE87006437	MN -70	12:22308
34	*See* PNL-SA-14263	E 1.99: DE87006434	MN -11	12:23531
35	*See* BNL-NUREG-39315	DE87006469	MN -70B	12:22256
37	*See* PNL-SA-14580	DE87006433	MN -71	12:23202
38	*See* BNL-NUREG-39319	DE87006470	MN -70B	12:22257
40	*See* PNL/SRP-SA-14323	E 1.99: DE87006439	MN -70	12:22860
42	*See* FMPC-2079	DE87006794	MN -70	12:22291
43	*See* GA-A-18751	E 1.99: DE87007048	MN -71	12:23196
CONF-870307-	(ASME/JSME/ISES solar energy conference, Honolulu, HI, USA, 22-27 Mar 1987)			
13	*See* HEDL-SA-3510-FP	E 1.99: DE87004434	MN -79	12:22515
18	*See* DOE/NASA/1005-12	E 1.99: DE87002961	STD -96	12:22477
CONF-870314-	(Corrosion '87, San Francisco, CA, USA, 9-13 Mar 1987)			
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006997	MN -11	12:23473
CONF-870320-	(Department of Energy international workshop on two-phase flow fundamentals, Troy, NY, USA, 16 Mar 1987)			
1	*See* EGG-M-14586	E 1.99: DE86013480	MN -80	12:23221

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CONF-870335-	(International conference on radiation dosimetry and safety, Taipei, China, 2-4 Mar 1987)			
3	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87004625	MN -41	12:23287
CONF-870364-	(Energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987)			
2	*See* LBL-22911	E 1.99: DE87006942	MN -61E	12:22355
CONF-870377-	(International congress on recent advances in the management of hazardous and toxic wastes in the process industries, Vienna, Austria, 8-13 Mar 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004261	MN -11	12:23143
CONF-870385-	(SPIE conference on growth of compound semiconductors, Bay Point, FL, USA, 22-27 Mar 1987)			
1	*See* SAND-86-2213C	E 1.99: DE87006712	MN -25	12:22958
2	*See* SAND-87-0437C	E 1.99: DE87006713	MN -25	12:22962
3	*See* SAND-86-2724C	E 1.99: DE87006891	MN -25	12:22960
5	*See* SAND-87-0261C	E 1.99: DE87006131	MN -34A	12:24116
CONF-870386-	(Applied systems analysis institute workshop on technological risk in modern society, Laxenburg, Austria, 18-20 Mar 1987)			
1	*See* UCRL-96081	E 1.99: DE87006243	MN -41	12:22442
CONF-870387-	(Workshop on refractory metals and silicides, Aussois, France, 24-26 Mar 1987)			
1	*See* SAND-87-0096C	DE87006124	MN -25	12:22867
CONF-870388-	(International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Mar 1987)			
1	*See* SAND-86-2570C	E 1.99: DE87006134	MN -25	12:22865
2	*See* SAND-86-2555C	E 1.99: DE87007086	MN -25	12:22959
CONF-870390-	(22. Recontres de Moriond: electroweak interactions and unified theories conference, Les Arcs, France, 8-15 Mar 1987)			
1	*See* SLAC-PUB-4165	E 1.99: DE87006777	MN -34D	12:23891
CONF-870393-	(18. Stadler genetics symposium: chromosome structure and function: the impact of new concepts, Columbia, MO, USA, 16-17 Mar 1987)			
1	*See* BNL-39310	E 1.99: DE87006915	MN -48	12:23535
CONF-870395-	(American Institute of Astronautics and Aeronautics, National Aeronautics and Space Administration and U.S. Air Force (AIAA/NASA/USAF) symposium on automation, robotics and advanced computing for the N, Arlington, VA, USA, 9-11 Mar 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007012	MN -86	12:23194
CONF-870399-	(9. international conference on software engineering, Boulder, CO, USA, 30 Mar-2 Apr 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007006	MN -32	12:24330
CONF-870405-	(Radiation protection and shielding conference, Knoxville, TN, USA, 22-24 Apr 1987)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004626	MN -20	12:24280
CONF-870410-	(193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987)			
15	*See* DOE/PC/90911-3	E 1.99: DE87002296	MN -90a	12:23094
CONF-870416-	(14. annual energy technology conference and exposition, Washington, DC, USA, 14-16 Apr 1987)			
1	*See* SAND-87-0058C	E 1.99: DE87005069	MN -63	12:22382
CONF-870424-	(American Nuclear Society international meeting on advances in reactor physics, mathematics and computation, Paris, France, 27-30 Apr 1987)			
1	*See* LA-UR-86-4389	DE87005943	MN -79p	12:22558
5	*See* LA-UR-87-87	E 1.99: DE87005112	MN -32	12:24340
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006992	MN -34C	12:24051
CONF-870444-	(16. international technical meeting on air pollution modelling and its application, Lindau, F.R. Germany, 6-10 Apr 1987)			
1	*See* LA-UR-87-678	E 1.99: DE87006067	MN -11	12:23416
CONF-870446-	(5. international modal analysis conference, London, UK, 6-9 Apr 1987)			
1	*See* SAND-86-1589C	DE87002698	MN -32	12:23189
CONF-870459-	(Workshop report on new directions in X-ray scattering, Pacific Grove, CA, USA, 2-5 Apr 1987)			
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CONF-870482-	(14. Department of Energy compatibility, aging and service life conference, Amarillo, TX, USA, 28-30 Apr 1987)			
1	*See* SAND-87-0218C	E 1.99: DE87005844	MN -38	12:23112
3	*See* SAND-87-0326C	E 1.99: DE87007024	MN -25	12:22961
CONF-870486-	(3. annual electronic packaging conference, Minneapolis, MN, USA, 27-30 Apr 1987)			
1	*See* LBL-22878	E 1.99: DE87006938	MN -25	12:23242
CONF-870513-	(171. Electrochemical Society meeting, Philadelphia, PA, USA, 10-15 May 1987)			
1	*See* SAND-86-1945C	E 1.99: DE87002696	MN -25	12:23244
2	*See* SAND-86-2797C	E 1.99: DE87003499	MN -25	12:22866
CONF-870523-	(9. symposium on biotechnology for fuels and chemicals, Boulder, CO, USA, 5-8 May 1987)			
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87005716	MN -61E	12:22363

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CONF-870538-	(34. international technical communication conference, Denver, CO, USA, 10-13 May 1987)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004966	MN -13	12:24376
CONF-870544-	(41. annual quality conference, Minneapolis, MN, USA, 4-6 May 1987)			
3	*See* UCRL-95891	E 1.99: DE87004356	MN -13	12:24316
CONF-870565-	(Department of Energy computer security group conference, Albuquerque, NM, USA, 5-7 May 1987)			
2	*See* RFP-4059	E 1.99: DE87004894	MN -13	12:24347
CONF-870726-	(1. international conference on industrial and applied mathematics, Paris, France, 1 Jul 1987, 1 Jul 1987)			
1	*See* DOE/ER/25026-1	E 1.99: DE87005543	MN -32	12:24377
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87-0040-Del.Ver.	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87005891	MN -2	12:22259
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85-48	*See* UCRL-92887	E 1.99: DE87006690	MN -34	12:22871
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86-04	NTIS (US Sales Only), PC A09/MF A01	DE87751145	MN -4	12:23162
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86-31	*See* AD-A-175931/5/XAB			12:23744
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010/ 86	NTIS (US Sales Only), PC A03/MF A01	DE87701612	MN -79	12:22467
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83/ 19G	NTIS (US Sales Only), PC A03/MF A01	DE87701498	MN -80	12:22497
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31	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87006873	STD -70	12:22262
DOE/NE/44506-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006474	MN -70	12:22263
DOE/OR/00033-T255	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87004882	MN -20	12:24191
T275	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87005963	MN -20	12:24192
T285	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006350	MN -20	12:24193
T286	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87005906	MN -2	12:22479
T289	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87007058	MN -13	12:24309
T290	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87007340	MN -13	12:24310

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T291	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007339	MN -13	12:24311
T292	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007338	MN -13	12:24312
DOE/OR/21400-				
T294	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006622	MN -95	12:22704
DOE/PC/70776-				
T10	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE87005863	STD -90a	12:22146
DOE/PC/70810-				
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007116	MN -90d	12:22130
DOE/PC/70812-				
10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007114	MN -90d	12:22131
DOE/PC/80517-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006804	MN -90b	12:22147
DOE/PC/80518-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007111	MN -90a	12:22132
DOE/PC/80522-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87007399	MN -90a	12:22148
DOE/PC/80525-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007683	MN -90b	12:22086
DOE/PC/80913-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007109	MN -90a	12:22133
DOE/PC/81543-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006752	MN -90d	12:22134
DOE/PC/90505-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006348	MN -90i	12:22156
DOE/PC/90528-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006805	MN -90d	12:22149
DOE/PC/90538-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87007108	MN -90a	12:22135
DOE/PC/90910-				
2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87006280	MN -90d	12:22136
DOE/PC/90911-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002296	MN -90a	12:23094
DOE/PC/90961-				
T2	NTIS, PC A02; 3	DE87007380	MN -90	12:23387
DOE/PC/91101-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007401	MN -90a	12:22157
DOE/PC/91404-				
T3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87007431	MN -90	12:22162
DOE/RA/50358-				
T1	NTIS, PC A06; 3	DE87007029	MN -95e	12:23492
DOE/S-				
0056	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87006156	MN -98F	12:23718
DOE/SF/15120-				
T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006803	MN -66c	12:22391
DP-MS-				
86-112	NTIS, PC A03; 3	DE87006272	MN -11	12:23474
EFI-				
797(24) -85	NTIS (US Sales Only), PC A02/MF A01	DE87701413	MN -34D	12:23855
806(33) -85	NTIS (US Sales Only), PC A02/MF A01	DE87701414	MN -34D	12:23856
EGG-				
2482	*See* NUREG/CR-4793	TI87006118	MN -78	12:22599
EGG-M-				
14586	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86013480	MN -80	12:23221
EIR-				
606	NTIS (US Sales Only), PC A02/MF A01	DE87701510	MN -80	12:22514
607	NTIS (US Sales Only), PC A02/MF A01	DE87701511	MN -4	12:22988
EML-				
458	NTIS, PC A04; 3	DE87006310	STD -11	12:23455
ENEA-RT-TIB-				
86/ 18	NTIS (US Sales Only), PC A03; 3	DE87900154	MN -32	12:24332
EPA-				
450/ 3-86/ 003	*See* PB-87-136800/XAB			12:23248
450/ 3-86/ 011	*See* PB-87-136966/XAB			12:22197
460/ 1-86/ 001	*See* PB-87-139168/XAB			12:22809
600/ 3-86/ 066	*See* PB-87-140919/XAB			12:23438
EPRI-AP-				
4922	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920316	ND -32	12:22801
5030	NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87006951	MN -90i	12:22137
5048	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920268	ND -90	12:22138
5059-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920265	ND -66	12:22394
EPRI-CS-				
5033	Research Reports Center Box 50490, Palo Alto, CA 94303	TI87920278	ND -90	12:22416
5034	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920274	ND -90e	12:22417
5035	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920276	ND -11	12:23532
5040	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920275	ND -90i	12:23429

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5069	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920271	ND -41	12:22418
EPRI-EA-				
5079	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920281	ND -11	12:23517
5091-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920282	ND -11	12:23413
EPRI-EL-				
4793-Vol.2-App.	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920320	ND -97a	12:22438
4894	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920285	ND -97c	12:22434
4912	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920286	ND -25	12:23195
EPRI-EL/EA-				
4858-Vol.3	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920287	ND -97	12:23095
EPRI-EM-				
3560-Vol.4	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920292	ND -98E	12:22439
5038	NTIS, PC A06/MF A01 - RRC, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87006952	MN -98	12:22691
5065	Research Reports Center, Box 50490, Palo Alto, CA 94303; 3	TI87920293	ND -97	12:22692
5094	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920289	ND -95d	12:22765
EPRI-NP-				
4611-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920297	ND -11	12:22517
5012	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920226	ND -80	12:22489
EPRI-P-				
5046	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920296	ND -98E	12:22693
5061	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920294	ND -13	12:22694
EUR-				
9708-Vol.1	NTIS (US Sales Only), PC A23/MF A01	DE87751134	MN -20a	12:24214
9708-Vol.2	NTIS (US Sales Only), PC A99/MF A01	DE87751132	MN -20a	12:24220
9762-Vol.1	NTIS (US Sales Only), PC A99/MF A01	DE87751063	MN -41	12:23289
9762-Vol.2	NTIS (US Sales Only), PC A99/MF A01	DE87751120	MN -41	12:23315
9866-Vol.1	NTIS (US Sales Only), PC A07/MF A01	DE87751128	MN -70	12:22264
9866-Vol.2	NTIS (US Sales Only), PC A02/MF A01	DE87751129	MN -70	12:22265
9866-Vol.3	NTIS (US Sales Only), PC A03/MF A01	DE87751121	MN -70	12:22266
9866-Vol.4	NTIS (US Sales Only), PC A03/MF A01	DE87751152	MN -70	12:22267
9866-Vol.5	NTIS (US Sales Only), PC A04/MF A01	DE87751124	MN -70	12:22268
9866-Vol.6	NTIS (US Sales Only), PC A08/MF A01	DE87751154	MN -70	12:22269
9866-Vol.7	NTIS (US Sales Only), PC A04/MF A01	DE87751123	MN -70	12:22270
9866-Vol.8	NTIS (US Sales Only), PC A03/MF A01	DE87751126	MN -70	12:22271
9866-Vol.9	NTIS (US Sales Only), PC A05/MF A01	DE87751153	MN -70	12:22272
9879-Vol.1	NTIS (US Sales Only), PC A04/MF A01	DE87751130	MN -70	12:22273
9879-Vol.2	NTIS (US Sales Only), PC A07/MF A01	DE87751131	MN -70	12:22274
10008	NTIS (US Sales Only), PC A03/MF A01	DE87751149	MN -11	12:23527
10023	NTIS (US Sales Only), PC A09/MF A01	DE87751140	MN -70	12:22275
10177	NTIS (US Sales Only), PC A03/MF A01	DE87751137	MN -70	12:22276
10190	NTIS (US Sales Only), PC A12/MF A01	DE87751148	MN -70	12:22277
10198	NTIS (US Sales Only), PC A05/MF A01	DE87751125	MN -70	12:22278
10200	NTIS (US Sales Only), PC A04/MF A01	DE87751122	MN -70	12:22279
10215	NTIS (US Sales Only), PC A02/MF A01	DE87751139	MN -70	12:22280
10226	NTIS (US Sales Only), PC A10/MF A01	DE87751151	MN -70	12:22281
10227	NTIS (US Sales Only), PC A02/MF A01	DE87751144	MN -70	12:22282
10231	NTIS (US Sales Only), PC A06/MF A01	DE87751138	MN -70	12:22283
10342	NTIS (US Sales Only), PC A12/MF A01	DE87751147	MN -70	12:22284
10378	NTIS (US Sales Only), PC A05/MF A01	DE87751127	MN -70	12:22285
10398	NTIS (US Sales Only), PC A08/MF A01	DE87751142	MN -70	12:22286
10399	NTIS (US Sales Only), PC A07/MF A01	DE87751135	MN -70	12:22287
10400	NTIS (US Sales Only), PC A04/MF A01	DE87751141	MN -70	12:22288
10405	NTIS (US Sales Only), PC A04/MF A01	DE87751143	MN -70	12:22289
10437	NTIS (US Sales Only), PC A05/MF A01	DE87751136	MN -70	12:22290
10532e	*See* KFK-4148	DE87751333	MN -78	12:22457
FMPC-				
2079	NTIS, PC A02; 3	DE87006794	MN -70	12:22291
FNAL/C-				
86/ 167	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006282	MN -34D	12:23857
FNAL/Pub-				
87/ 19-E	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006420	MN -34D	12:23858
FRADOC-				
9-7	NTIS (US Sales Only), PC A02/MF A01	DE87751006	MN -80	12:22490
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18751	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007048	MN -71	12:23196
GKSS-				
86/ E/ 1	NTIS (US Sales Only), PC A03/MF A01	DE87751342	MN -13	12:24313
86/ E/ 29	NTIS (US Sales Only), PC A02/MF A01	DE87751178	MN -4	12:22989
86/ E/ 32	NTIS (US Sales Only), PC A06/MF A01	DE87751231	MN -80	12:22518

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86/ E/ 33	NTIS (US Sales Only), PC A03/MF A01	DE87751235	MN -4	12:22990
86/ E/ 35	NTIS (US Sales Only), PC A03/MF A01	DE87751209	MN -11	12:23414
86/ E/ 36	NTIS (US Sales Only), PC A07/MF A01	DE87751212	MN -38	12:23222
GSF-				
18/ 86	NTIS (US Sales Only), PC A04/MF A01	DE87751227	MN -11	12:23484
GSF-BPT-				
4/ 86	NTIS (US Sales Only), PC A06/MF A01	DE87751335	MN -48	12:23634
GSI-				
86-14	NTIS (US Sales Only), PC A03/MF A01	DE87751230	MN -28	12:23276
86-25-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE87751184	MN -34A	12:23801
86-33-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751185	MN -34A	12:23802
86-34-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751229	MN -34A	12:23803
86-42-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE87751183	MN -28	12:23269
86-43-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751179	MN -28	12:23261
86-44-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751223	MN -34D	12:24145
86-46-Prepr.	NTIS (US Sales Only), PC A04/MF A01	DE87751236	MN -34C	12:23989
HEDL-				
7651	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007695	MN -83	12:22240
HEDL-SA-				
3459-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005463	MN -32	12:24333
3510-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004434	MN -79	12:22515
3551-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005461	MN -79b	12:22519
HMI-B-				
432	NTIS (US Sales Only), PC A08/MF A01	DE87751221	MN -11	12:23430
435	NTIS (US Sales Only), PC A03/MF A01	DE87751225	MN -37	12:23350
IAEA-CN-				
47/ F-IV-4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006664	MN -20f	12:24243
IAEA-R-				
3897-F	NTIS (US Sales Only), PC A04/MF A01	DE87701512	MN -48	12:23584
4169-F	NTIS (US Sales Only), PC A04/MF A01	DE87701513	MN -16	12:22334
IAEA-RL-				
127	NTIS (US Sales Only), PC A05/MF A01	DE87701514	MN -4	12:22997
IAEA-SR-				
124/ 20	*See* PPA-T-45	DE87701627	MN -2	12:22482
IAEA-TECDOC-				
381	NTIS (US Sales Only), PC A11/MF A01	DE87701515	MN -11	12:23499
390	NTIS (US Sales Only), PC A05/MF A01	DE87701516	MN -80	12:22491
392	NTIS (US Sales Only), PC A04/MF A01	DE87701617	MN -48	12:23620
IAN-AIM-				
4	NTIS (US Sales Only), PC A03/MF A01	DE87701517	MN -2	12:24320
5	NTIS (US Sales Only), PC A05/MF A01	DE87701518	MN -25	12:23230
IAN-SR-				
9	NTIS (US Sales Only), PC A04/MF A01	DE87701519	MN -41	12:24093
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86/ 47	NTIS (US Sales Only), PC A02/MF A01	DE87701403	MN -34B	12:23751
86/ 52	NTIS (US Sales Only), PC A02/MF A01	DE87701425	MN -34C	12:23990
86/ 69	NTIS (US Sales Only), PC A02/MF A01	DE87701406	MN -34B	12:23752
86/ 74	NTIS (US Sales Only), PC A02/MF A01	DE87701407	MN -34B	12:23753
86/ 75	NTIS (US Sales Only), PC A03/MF A01	DE87701408	MN -34B	12:23754
86/ 84	NTIS (US Sales Only), PC A03/MF A01	DE87701421	MN -34D	12:23859
86/ 86	NTIS (US Sales Only), PC A03/MF A01	DE87701416	MN -34D	12:23860
86/ 120	NTIS (US Sales Only), PC A02/MF A01	DE87701410	MN -34A	12:24140
86/ 128	NTIS (US Sales Only), PC A02/MF A01	DE87701432	MN -34C	12:23991
86/ 132	NTIS (US Sales Only), PC A02/MF A01	DE87701415	MN -34D	12:23861
86/ 146	NTIS (US Sales Only), PC A02/MF A01	DE87701459	MN -48	12:23621
86/ 148	NTIS (US Sales Only), PC A02/MF A01	DE87701405	MN -34B	12:23755
86/ 149	NTIS (US Sales Only), PC A02/MF A01	DE87701520	MN -34A	12:24101
86/ 150	NTIS (US Sales Only), PC A02/MF A01	DE87701521	MN -34A	12:24102
86/ 153	NTIS (US Sales Only), PC A02/MF A01	DE87701522	MN -34D	12:23909
86/ 155	NTIS (US Sales Only), PC A02/MF A01	DE87701523	MN -34D	12:24146
86/ 157	NTIS (US Sales Only), PC A03/MF A01	DE87701524	MN -34A	12:23804
86/ 160	NTIS (US Sales Only), PC A02/MF A01	DE87701525	MN -34C	12:23992
86/ 164	NTIS (US Sales Only), PC A02/MF A01	DE87701526	MN -34D	12:24147
86/ 169	NTIS (US Sales Only), PC A02/MF A01	DE87701527	MN -20	12:24244
86/ 173	NTIS (US Sales Only), PC A02/MF A01	DE87701528	MN -20	12:24245
86/ 180	NTIS (US Sales Only), PC A03/MF A01	DE87701529	MN -34D	12:24148
86/ 181	NTIS (US Sales Only), PC A02/MF A01	DE87701530	MN -34B	12:23756
86/ 182	NTIS (US Sales Only), PC A02/MF A01	DE87701531	MN -34D	12:24149
86/ 186	NTIS (US Sales Only), PC A02/MF A01	DE87701532	MN -20	12:24246
86/ 187	NTIS (US Sales Only), PC A02/MF A01	DE87701533	MN -34A	12:24103
86/ 189	NTIS (US Sales Only), PC A02/MF A01	DE87701534	MN -34D	12:23910
86/ 195	NTIS (US Sales Only), PC A02/MF A01	DE87701535	MN -34D	12:24150
86/ 196	NTIS (US Sales Only), PC A03/MF A01	DE87701536	MN -34D	12:24151
86/ 197	NTIS (US Sales Only), PC A02/MF A01	DE87701537	MN -34A	12:24104
86/ 199	NTIS (US Sales Only), PC A02/MF A01	DE87701538	MN -34A	12:24141
86/ 200	NTIS (US Sales Only), PC A02/MF A01	DE87701539	MN -34C	12:23993
86/ 201	NTIS (US Sales Only), PC A02/MF A01	DE87701540	MN -34D	12:24152
86/ 202	NTIS (US Sales Only), PC A02/MF A01	DE87701541	MN -34D	12:24153
86/ 203	NTIS (US Sales Only), PC A02/MF A01	DE87701542	MN -34A	12:24105
86/ 204	NTIS (US Sales Only), PC A02/MF A01	DE87701543	MN -34D	12:24154
86/ 208	NTIS (US Sales Only), PC A02/MF A01	DE87701544	MN -34A	12:24106
86/ 214	NTIS (US Sales Only), PC A02/MF A01	DE87701545	MN -34D	12:24155
86/ 221	NTIS (US Sales Only), PC A02/MF A01	DE87701546	MN -34D	12:24156
86/ 223	NTIS (US Sales Only), PC A02/MF A01	DE87701547	MN -34A	12:24107

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86/ 231	NTIS (US Sales Only), PC A02/MF A01	DE87701548	MN -34A	12:23805
86/ 234	NTIS (US Sales Only), PC A02/MF A01	DE87701549	MN -34A	12:24108
86/ 236	NTIS (US Sales Only), PC A02/MF A01	DE87701550	MN -34A	12:24109
86/ 237	NTIS (US Sales Only), PC A02/MF A01	DE87701551	MN -34D	12:24157
86/ 238	NTIS (US Sales Only), PC A02/MF A01	DE87701552	MN -34D	12:24158
86/ 242	NTIS (US Sales Only), PC A03/MF A01	DE87701553	MN -34A	12:23806
86/ 250	NTIS (US Sales Only), PC A02/MF A01	DE87701554	MN -34D	12:24159
86/ 254	NTIS (US Sales Only), PC A02/MF A01	DE87701555	MN -34D	12:24160
86/ 260	NTIS (US Sales Only), PC A02/MF A01	DE87701556	MN -34A	12:23807
86/ 262	NTIS (US Sales Only), PC A02/MF A01	DE87701557	MN -34D	12:23916
86/ 272	NTIS (US Sales Only), PC A02/MF A01	DE87701558	MN -34D	12:24161
86/ 291	NTIS (US Sales Only), PC A02/MF A01	DE87701559	MN -34B	12:23757
86/ 295	NTIS (US Sales Only), PC A02/MF A01	DE87701560	MN -34D	12:24162
86/ 309	NTIS (US Sales Only), PC A02/MF A01	DE87701561	MN -61	12:23740
86/ 329	NTIS (US Sales Only), PC A02/MF A01	DE87701562	MN -34D	12:24163
IEAL-R-				
86-65-Summ.	NTIS (US Sales Only), PC A02/MF A01	DE87750703	MN -70	12:22247
86-65-Vol.1	NTIS (US Sales Only), PC A14/MF A01	DE87750700	MN -70	12:22684
86-65-Vol.2	NTIS (US Sales Only), PC A05/MF A01	DE87750701	MN -70	12:22248
86-65-Vol.3	NTIS (US Sales Only), PC A06/MF A01	DE87750702	MN -70	12:22249
IEPA/ENV-				
86-008	*See* PB-87-129839/XAB			12:22666
IFE/KR/E-				
86/ 001	NTIS (US Sales Only), PC A03/MF A01	DE87750689	MN -2	12:22481
86/ 002	NTIS (US Sales Only), PC A02/MF A01	DE87750688	MN -38	12:22999
86/ 003	NTIS (US Sales Only), PC A02/MF A01	DE87750697	MN -41	12:23485
86-004	NTIS (US Sales Only), PC A03/MF A01	DE87750695	MN -41	12:22520
86/ 005	NTIS (US Sales Only), PC A03/MF A01	DE87750896	MN -86	12:22241
IFJ-				
1278	*See* INP-1278	DE87701424	MN -34C	12:23934
IFVE-OEF-				
85-19	NTIS (US Sales Only), PC A02/MF A01	DE87701422	MN -34D	12:23828
IFVE-OTF-				
85-123	NTIS (US Sales Only), PC A02/MF A01	DE87701417	MN -34D	12:23862
IITRI-P-				
06059-1	*See* UCRL-15882	E 1.99: DE87006721	MN -25	12:22868
IKMz-				
86-1	NTIS (US Sales Only), PC A04/MF A01	DE87751317	MN -34C	12:23984
IL/SGS/IMN-				
95	*See* PB-87-139341/XAB			12:22671
INDC(CPR)-				
010/ L	NTIS (US Sales Only), PC A03/MF A01	DE87701563	MN -34C	12:23957
INIS-BR-				
577	NTIS (US Sales Only), PC A02/MF A01	DE87701446	MN -4	12:23000
579	NTIS (US Sales Only), PC A02/MF A01	DE87701618	MN -37	12:23351
580	NTIS (US Sales Only), PC A02/MF A01	DE87701619	MN -23	12:22347
581	NTIS (US Sales Only), PC A02/MF A01	DE87701620	MN -25	12:23231
582	NTIS (US Sales Only), PC A02/MF A01	DE87701621	MN -25	12:23232
583	NTIS (US Sales Only), PC A02/MF A01	DE87701622	MN -2	12:23639
INIS-mf-				
10247	NTIS (US Sales Only), PC A03/MF A01	DE87751204	MN -80	12:22521
10253	NTIS (US Sales Only), PC A06/MF A01	DE87751341	MN -34C	12:24057
10298	NTIS (US Sales Only), PC A04/MF A01	DE87751177	MN -11	12:23529
10299	NTIS (US Sales Only), PC A08/MF A01	DE87751189	MN -34C	12:23994
10300	NTIS (US Sales Only), PC A07/MF A01	DE87751192	MN -34C	12:23995
10319	NTIS (US Sales Only), PC A02/MF A01	DE87751191	MN -13	12:22443
10320	NTIS (US Sales Only), PC A08/MF A01	DE87751182	MN -77	12:22463
10321	NTIS (US Sales Only), PC A02/MF A01	DE87751181	MN -77	12:22464
10322	NTIS (US Sales Only), PC A05/MF A01	DE87751210	MN -70	12:22292
10323	NTIS (US Sales Only), PC A06/MF A01	DE87751211	MN -80	12:22522
10324	NTIS (US Sales Only), PC A07/MF A01	DE87751197	MN -34C	12:23996
10325	NTIS (US Sales Only), PC A05/MF A01	DE87751196	MN -34A	12:23808
10326	NTIS (US Sales Only), PC A06/MF A01	DE87751312	MN -34C	12:23954
10327	NTIS (US Sales Only), PC A05/MF A01	DE87751193	MN -34C	12:23958
10328	NTIS (US Sales Only), PC A05/MF A01	DE87751194	MN -34D	12:23863
10329	NTIS (US Sales Only), PC A02/MF A01	DE87751199	MN -80	12:22523
10330	NTIS (US Sales Only), PC A02/MF A01	DE87751187	MN -34D	12:23917
10332	NTIS (US Sales Only), PC A03/MF A01	DE87751200	MN -80	12:22524
10333	NTIS (US Sales Only), PC A02/MF A01	DE87751201	MN -80	12:22525
10334	NTIS (US Sales Only), PC A03/MF A01	DE87751202	MN -80	12:22526
10335	NTIS (US Sales Only), PC A10/MF A01	DE87751336	MN -80	12:22527
10336	NTIS (US Sales Only), PC A02/MF A01	DE87751203	MN -11	12:23457
10337	NTIS (US Sales Only), PC A08/MF A01	DE87751313	MN -34C	12:23997
10338	NTIS (US Sales Only), PC A08/MF A01	DE87751314	MN -34C	12:23972
10339	NTIS (US Sales Only), PC A06/MF A01	DE87751315	MN -37	12:23352
10341	NTIS (US Sales Only), PC A05/MF A01	DE87751319	MN -34C	12:23968
10342	NTIS (US Sales Only), PC A04/MF A01	DE87751320	MN -34C	12:23964
10343	NTIS (US Sales Only), PC A05/MF A01	DE87751321	MN -34C	12:23947
10344	NTIS (US Sales Only), PC A07/MF A01	DE87751324	MN -34C	12:23959
10345	NTIS (US Sales Only), PC A06/MF A01	DE87751323	MN -34C	12:23960
10346	NTIS (US Sales Only), PC A02/MF A01	DE87751329	MN -86	12:22242
10347	NTIS (US Sales Only), PC A21/MF A01	DE87751343	MN -13	12:24378
10348	NTIS (US Sales Only), PC A02/MF A01	DE87751328	MN -34D	12:24164
10349	NTIS (US Sales Only), PC A02/MF A01	DE87751327	MN -34D	12:24165

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10350	NTIS (US Sales Only), PC A02/MF A01	DE87751326	MN -34D	12:24166
10351	NTIS (US Sales Only), PC A02/MF A01	DE87751325	MN -34D	12:24167
10352	NTIS (US Sales Only), PC A07/MF A01	DE87751220	MN -80	12:22528
10353	NTIS (US Sales Only), PC A08/MF A01	DE87751311	MN -34C	12:23948
10513	NTIS (US Sales Only), PC A03/MF A01	DE87701564	MN -4	12:23001
10520	NTIS (US Sales Only), PC A02/MF A01	DE87701565	MN -2	12:24321
10521	NTIS (US Sales Only), PC A04/MF A01	DE87701566	MN -4	12:23002
10522	NTIS (US Sales Only), PC A07/MF A01	DE87701567	MN -20	12:24288
10526	NTIS (US Sales Only), PC A07/MF A01	DE87701568	MN -48	12:23585
10527	NTIS (US Sales Only), PC A03/MF A01	DE87701569	MN -41	12:22499
10529	NTIS (US Sales Only), PC A03/MF A01	DE87750664	MN -80	12:22441
10530	NTIS (US Sales Only), PC A02/MF A01	DE87750671	MN -41	12:23458
10531	NTIS (US Sales Only), PC A02/MF A01	DE87750672	MN -41	12:23459
10532	NTIS (US Sales Only), PC A02/MF A01	DE87750673	MN -41	12:23460
10533	NTIS (US Sales Only), PC A03/MF A01	DE87750674	MN -86	12:22243
10534	NTIS (US Sales Only), PC A04/MF A01	DE87750685	MN -80	12:22500
10535	NTIS (US Sales Only), PC A03/MF A01	DE87750686	MN -70	12:24379
10536	NTIS (US Sales Only), PC A03/MF A01	DE87750687	MN -25	12:22837
10537	NTIS (US Sales Only), PC A02/MF A01	DE87750692	MN -41	12:23461
10550	NTIS (US Sales Only), PC A05/MF A01	DE87701570	MN -4	12:23003
10568	NTIS (US Sales Only), PC A03/MF A01	DE87701571	MN -48	12:23586
10569	NTIS (US Sales Only), PC A03/MF A01	DE87750906	MN -78	12:22444
10574	NTIS (US Sales Only), PC A05/MF A01	DE87701448	MN -4	12:23154
10575	NTIS (US Sales Only), PC A05/MF A01	DE87701445	MN -4	12:23011
10576	NTIS (US Sales Only), PC A02/MF A01	DE87701460	MN -23	12:23640
10577	NTIS (US Sales Only), PC A03/MF A01	DE87701572	MN -4	12:23021
10578	NTIS (US Sales Only), PC A22/MF A01	DE87780106	MN -48	12:23542
10580-Vol.1	NTIS (US Sales Only), PC A07/MF A01	DE87780112	MN -80	12:22536
10580-Vol.2	NTIS (US Sales Only), PC A10/MF A01	DE87780113	MN -80	12:22552
10581	NTIS (US Sales Only), PC A13/MF A01	DE87701623	MN -4	12:23034
10585	NTIS (US Sales Only), PC A03/MF A01	DE87750699	MN -41	12:22553
10586	NTIS (US Sales Only), PC A02/MF A01	DE87701574	MN -2	12:24322
10587	NTIS (US Sales Only), PC A10/MF A01	DE87701624	MN -41	12:22295
10588	NTIS (US Sales Only), PC A05/MF A01	DE87701625	MN -2	12:24383
10589	NTIS (US Sales Only), PC A07/MF A01	DE87701626	MN -34D	12:23820
INIS-SU-				
384	NTIS (US Sales Only), PC A04/MF A01	DE87780105	MN -34	12:24248
401	NTIS (US Sales Only), PC A04/MF A01	DE87780111	MN -34D	12:23743
INP-				
1171/ PL	NTIS (US Sales Only), PC A02/MF A01	DE87701575	MN -41	12:23463
1202/ PH	NTIS (US Sales Only), PC A02/MF A01	DE87701576	MN -34D	12:23880
1215/ C	NTIS (US Sales Only), PC A02/MF A01	DE87701577	MN -4	12:23070
1226/ C	NTIS (US Sales Only), PC A02/MF A01	DE87701578	MN -4	12:23071
1227/ PL	NTIS (US Sales Only), PC A03/MF A01	DE87701430	MN -34C	12:24023
1232/ AP	NTIS (US Sales Only), PC A08/MF A01	DE87701579	MN -46	12:24058
1278	NTIS (US Sales Only), PC A99/MF A01	DE87701424	MN -34C	12:23934
INR-				
1901/ 22/ C/ B	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -86	12:22244
1938/ 14/ PS/ A	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -4	12:23106
1946/ 14/ PS/ A	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -4	12:23107
1947/ 22/ C/ B	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -86	12:22245
1954/ 15-A/ C/ B	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -51	12:23072
1961/ 14/ R/ B	Power System Computer Centre. Mining and Power System Information Department, Palace of Culture and Science, PL-00-901 Warsaw, Poland		ND -25	12:22843
IPPJ-				
757	NTIS (US Sales Only), PC A02/MF A01	DE87701580	MN -20	12:24251
IS-J-				
2453	*See* DOE/ER/40200-087	E 1.99: DE87006233	MN -34D	12:23853
ISPO-				
210	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007350	MN -15	12:22337
ISS-L-				
84/ 7	NTIS (US Sales Only), PC A05/MF A01	DE87900284	MN -84	12:23644
ITEF-				
59(1985)	NTIS (US Sales Only), PC A02/MF A01	DE87701437	MN -34C	12:23938
ITEP-				
78(1985)	NTIS (US Sales Only), PC A03/MF A01	DE87701433	MN -34C	12:24024
ITF-				
86-51-R	NTIS (US Sales Only), PC A02/MF A01	DE87701581	MN -34C	12:24025
JAERI-M-				
85-168	NTIS (US Sales Only), PC A05/MF A01	DE87701582	MN -70	12:22296
86-002	NTIS (US Sales Only), PC A03/MF A01	DE87701583	MN -23	12:22349
86-009	NTIS (US Sales Only), PC A10/MF A01	DE87780110	MN -78	12:22446
86-013	NTIS (US Sales Only), PC A02/MF A01	DE87701584	MN -70	12:22297

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86-014	NTIS (US Sales Only), PC A02/MF A01	DE87701585	MN -70	12:22298
86-023	NTIS (US Sales Only), PC A04/MF A01	DE87701586	MN -32	12:24338
86-061	NTIS (US Sales Only), PC A03/MF A01	DE87701587	MN -20	12:24290
86-064	NTIS (US Sales Only), PC A08/MF A01	DE87701588	MN -20	12:24291
JINR-				
8-85-756	NTIS (US Sales Only), PC A02/MF A01	DE87701409	MN -34A	12:23199
E-1-86-78	NTIS (US Sales Only), PC A02/MF A01	DE87701439	MN -34C	12:23945
E-2-85-739	NTIS (US Sales Only), PC A02/MF A01	DE87701418	MN -34D	12:23881
E-4-85-934	NTIS (US Sales Only), PC A02/MF A01	DE87701436	MN -34C	12:24026
E-4-85-953	NTIS (US Sales Only), PC A02/MF A01	DE87701402	MN -20	12:24292
E-4-86-86	NTIS (US Sales Only), PC A02/MF A01	DE87701434	MN -34C	12:24027
E-14-85-789	NTIS (US Sales Only), PC A02/MF A01	DE87701450	MN -25	12:22844
E-17-85-967	NTIS (US Sales Only), PC A02/MF A01	DE87701589	MN -34D	12:24176
R-1-85-939	NTIS (US Sales Only), PC A02/MF A01	DE87701423	MN -34D	12:23835
R-1-86-117	NTIS (US Sales Only), PC A02/MF A01	DE87701441	MN -34C	12:23962
R-2-85-974	NTIS (US Sales Only), PC A02/MF A01	DE87701419	MN -34D	12:23882
R-2-86-32	NTIS (US Sales Only), PC A02/MF A01	DE87701412	MN -34D	12:23883
R-2-86-101	NTIS (US Sales Only), PC A02/MF A01	DE87701411	MN -34D	12:23884
R-4-85-908	NTIS (US Sales Only), PC A02/MF A01	DE87701435	MN -34C	12:24028
R-4-85-960	NTIS (US Sales Only), PC A02/MF A01	DE87701426	MN -34C	12:24029
R-4-86-42	NTIS (US Sales Only), PC A02/MF A01	DE87701427	MN -34C	12:24030
R-4-86-53	NTIS (US Sales Only), PC A02/MF A01	DE87701428	MN -34C	12:24031
R-6-85-792	NTIS (US Sales Only), PC A02/MF A01	DE87701438	MN -34C	12:23977
R-6-85-813	NTIS (US Sales Only), PC A02/MF A01	DE87701442	MN -34C	12:23978
R-6-85-874	NTIS (US Sales Only), PC A02/MF A01	DE87701447	MN -4	12:22395
R-15-85-775	NTIS (US Sales Only), PC A02/MF A01	DE87701440	MN -34C	12:23951
R-19-85-822	NTIS (US Sales Only), PC A02/MF A01	DE87701456	MN -48	12:23645
R-19-85-824	NTIS (US Sales Only), PC A02/MF A01	DE87701457	MN -48	12:23646
R-19-86-38	NTIS (US Sales Only), PC A02/MF A01	DE87701458	MN -48	12:23647
JPL-D-				
1599	*See* AD-A-175749/1/XAB			12:22190
Juel-				
2041	NTIS (US Sales Only), PC A07/MF A01	DE87751198	MN -20d	12:24293
2052	NTIS (US Sales Only), PC A04/MF A01	DE87751322	MN -25	12:22951
2056	NTIS (US Sales Only), PC A03/MF A01	DE87751345	MN -20d	12:24294
2062	NTIS (US Sales Only), PC A03/MF A01	DE87751190	MN -28	12:23279
2066	NTIS (US Sales Only), PC A04/MF A01	DE87751339	MN -25	12:22845
2068	NTIS (US Sales Only), PC A07/MF A01	DE87751284	MN -34C	12:24032
2071	NTIS (US Sales Only), PC A07/MF A01	DE87751213	MN -38	12:23223
2072	NTIS (US Sales Only), PC A07/MF A01	DE87751219	MN -77	12:22465
2073	NTIS (US Sales Only), PC A08/MF A01	DE87751348	MN -77	12:22466
2074	NTIS (US Sales Only), PC A08/MF A01	DE87751338	MN -25	12:22846
Juel-Spez-				
291	NTIS (US Sales Only), PC A11/MF A01	DE87751334	MN -98	12:22657
340	NTIS (US Sales Only), PC A06/MF A01	DE87751217	MN -34C	12:24033
341	NTIS (US Sales Only), PC A07/MF A01	DE87751218	MN -34C	12:24034
351	NTIS (US Sales Only), PC A04/MF A01	DE87751188	MN -11	12:23415
359	NTIS (US Sales Only), PC A06/MF A01	DE87751216	MN -25	12:22952
362	NTIS (US Sales Only), PC A03/MF A01	DE87751186	MN -38	12:23224
365	NTIS (US Sales Only), PC A08/MF A01	DE87751318	MN -4	12:23073
371	NTIS (US Sales Only), PC A07/MF A01	DE87751233	MN -34C	12:24035
KAERC-				
102/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87701429	MN -34C	12:24036
KFK-				
4010-B	NTIS (US Sales Only), PC A06/MF A01	DE87751180	MN -37	12:23364
4083	NTIS (US Sales Only), PC A07/MF A01	DE87751215	MN -25	12:22847
4093	NTIS (US Sales Only), PC A09/MF A01	DE87751331	MN -79	12:22469
4097	NTIS (US Sales Only), PC A03/MF A01	DE87751346	MN -20d	12:24295
4116	NTIS (US Sales Only), PC A06/MF A01	DE87751205	MN -80	12:22484
4119	NTIS (US Sales Only), PC A04/MF A01	DE87751206	MN -37	12:23365
4121	NTIS (US Sales Only), PC A04/MF A01	DE87751214	MN -25	12:22848
4128	NTIS (US Sales Only), PC A05/MF A01	DE87751340	MN -34D	12:23836
4129	NTIS (US Sales Only), PC A09/MF A01	DE87751234	MN -79	12:22470
4139	NTIS (US Sales Only), PC A03/MF A01	DE87751330	MN -79	12:22471
4144	NTIS (US Sales Only), PC A05/MF A01	DE87751344	MN -25	12:22849
4148	NTIS (US Sales Only), PC A06/MF A01	DE87751333	MN -78	12:22457
4150	NTIS (US Sales Only), PC A04/MF A01	DE87751337	MN -25	12:22853
4158	NTIS (US Sales Only), PC A04/MF A01	DE87751232	MN -34C	12:23946
4160	NTIS (US Sales Only), PC A05/MF A01	DE87751332	MN -80	12:22492
4162	NTIS (US Sales Only), PC A05/MF A01	DE87751208	MN -78	12:22458
4168	NTIS (US Sales Only), PC A03/MF A01	DE87751237	MN -21	12:24296
KFKI-				
1986-34/ C	NTIS (US Sales Only), PC A02/MF A01	DE87701404	MN -34B	12:23762
1986-53/ A	NTIS (US Sales Only), PC A02/MF A01	DE87701431	MN -34C	12:24037
1986-64/ A	NTIS (US Sales Only), PC A03/MF A01	DE87701420	MN -34D	12:23886
LA-				
164/ 86	*See* OEFZS-4370	DE87701590	MN -48	12:23650
10787-PR	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87007725	STD -15	12:22338
10829-MS	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87006324	STD -32	12:24339
10871-MS	*See* NUREG/CR-4776	TI87006653	MN -38	12:23200
10893-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006321	STD -11	12:23489
10894-MS	NTIS, PC A02/MF A01	DE87007714	STD -45	12:23394
10912-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007707	STD -15	12:22339
10923-OBES	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87007722	STD -66b	12:22392

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10934-OBES	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007723	STD -66c	12:22393
10940-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006323	STD -2	12:22813
10941-T	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006168	STD -34C	12:23952
10950-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007710	STD -25	12:22854
LA-tr-					
87-7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006227	MN -38	12:24372
87-9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007075	MN -37	12:23391
LA-UR-					
86-4389	NTIS, PC A02; 3		DE87005943	MN -79p	12:22558
87-87	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005112	MN -32	12:24340
87-258	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005095	MN -11	12:24177
87-297	NTIS, PC A02; 3		DE87006074	MN -28	12:23270
87-310	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006071	MN -25	12:22855
87-352	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006068	MN -34	12:24341
87-354	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006049	MN -28	12:23271
87-356	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006050	MN -34D	12:23811
87-383	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006052	MN -38	12:23241
87-389	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87006053	MN -25	12:24142
87-438	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006055	MN -25	12:22856
87-455	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006057	MN -25	12:22857
87-634	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006061	MN -34D	12:23919
87-660	NTIS, PC A02; 3		DE87006063	MN -28	12:23272
87-663	NTIS, PC A02; 3		DE87006064	MN -28	12:23280
87-669	NTIS, PC A02; 3		DE87006065	MN -28	12:23281
87-673	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006066	MN -32	12:24342
87-678	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87006067	MN -11	12:23416
LAL-					
86-11	NTIS (US Sales Only), PC A02/MF A01		DE87751064	MN -34D	12:23837
LBL-					
20765	NTIS, PC A02; 3		DE87006145	MN -48	12:23716
21747	NTIS, PC A02; 3		DE87006146	MN -32	12:24380
22321	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006946	MN -48	12:23717
22433	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006248	MN -34D	12:23838
22534	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004599	MN -4	12:23108
22576	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007165	MN -94c	12:22644
22608	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007166	MN -25	12:24114
22640	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006929	MN -34A	12:23812
22664	NTIS, PC A11; 3		DE87007177	MN -92	12:22206
22688	NTIS, PC A03; 3		DE87006936	MN -95d	12:22766
22696	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007168	MN -25	12:22927
22719	NTIS, PC A08; 3		DE87006930	MN -66	12:22388
22796	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006249	MN -34D	12:23920
22848	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006932	MN -32	12:24381
22878	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006938	MN -25	12:23242
22911	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006942	MN -61E	12:22355
LBL-PUB-					
458	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006173	MN -28	12:23264
606	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006931	MN -25	12:22953
LRP-					
252/ 84	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900202	MN -20	12:24252
LUIP-					
8503	NTIS (US Sales Only), PC A02/MF A01		DE87750904	MN -34C	12:24038
8606	NTIS (US Sales Only), PC A03/MF A01		DE87750903	MN -34D	12:23839
LUNFD6/NFFK-					
7056-1-9(1985)	*See* LUIP-8503		DE87750904	MN -34C	12:24038
7072-1-31(1986)	*See* LUIP-8606		DE87750903	MN -34D	12:23839
LUTKDH/TKKA-					
1003-1-13(1986)	NTIS (US Sales Only), PC A02/MF A01		DE87750905	MN -86	12:22237
METC-					
86-TR-1	*See* DOE/MC/21389-2051	E 1.99:	DE87007096	MN -90f	12:22169
MINTEK-M-					
236	NTIS (US Sales Only), PC A03/MF A01		DE87701449	MN -86	12:22238
MPI-PAE/Exp.El.-					
160	NTIS (US Sales Only), PC A03/MF A01		DE87751228	MN -37	12:23366
NASA-TM-					
88846	*See* DOE/NASA/1005-11		DE87004810	MN -96	12:22806
88886	*See* DOE/NASA/1005-12	E 1.99:	DE87002961	STD -96	12:22477
88952	*See* DOE/NASA/16310-2	E 1.99:	DE87006776	STD -25	12:22829
NBI-HE-					
86-12	NTIS (US Sales Only), PC A03/MF A01		DE87751239	MN -34D	12:23921
86-14	NTIS (US Sales Only), PC A04/MF A01		DE87751238	MN -34D	12:23922
86-28	NTIS (US Sales Only), PC A03/MF A01		DE87751352	MN -34D	12:23923
86-29	NTIS (US Sales Only), PC A03/MF A01		DE87751349	MN -34D	12:23911
86-33	NTIS (US Sales Only), PC A03/MF A01		DE87751351	MN -34D	12:23887
86-34	NTIS (US Sales Only), PC A02/MF A01		DE87751350	MN -34D	12:23912
NBL-					
306	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004733	MN -15	12:23074
NBS-SP-					
726	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006799	MN -32	12:22818
NCAR/TN-					
274-STR	*See* PB-87-138095/XAB				12:23766
NCAR-TN/STR-					
273	*See* DOE/ER/60085-H1		DE87006903	MN -11	12:23412

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NCEL-TN-				
1761	*See* AD-A-175762/4/XAB			12:23247
NILU-TR-				
7/ 86	NTIS (US Sales Only), PC A03/MF A01	DE87750895	MN -41	12:22559
NIPER-				
226	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001229	STD -92	12:22187
NKA/LIT-				
85-1	NTIS (US Sales Only), PC A02/MF A01	DE87750675	MN -80	12:22498
NMRDI-				
2-75-PSTS	NTIS, PC A07/MF A01 - NMRDI, 457 Washington SE, Suite M, Albuquerque, NM 87108; 2	DE87900545	MN -59B	12:22385
NORDITA-				
84/ 39-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751245	MN -34A	12:23813
84/ 46-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751240	MN -34D	12:24039
84/ 47-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751246	MN -34	12:24343
85/ 9-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE87751247	MN -34D	12:24178
85/ 14-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751248	MN -34	12:24115
85/ 22-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE87751242	MN -34D	12:24179
85/ 25-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE87751243	MN -34D	12:24040
85/ 27-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751244	MN -38	12:23225
85/ 30-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE87751241	MN -34D	12:23924
NP-				
7900551	School of Mines & Energy Development, Box 6282, Univ. of Alabama, Tuscaloosa, AL 35486	TI87900551	MN -95d	12:22767
NRL-				
8859	*See* AD-A-175711/1/XAB			12:24050
NTB-				
85-09	Nagra, Ch-5401 Baden, Switzerland		ND -70	12:22299
85-16	Nagra, Ch-5401 Baden, Switzerland		ND -48	12:23490
NUREG-				
0304-Vol.11-No.4	NTIS, PC A10/MF A01 - GPO	TI87900559	MN -2	12:22480
0750-Vol.24-No.2	NTIS, PC A10/MF A01 - GPO	TI87900548	MN -2	12:22680
1101-Vol.2	NTIS, PC A03/MF A01 - GPO	TI87900564	MN -70B	12:22300
1137-Suppl.6	NTIS, PC A06/MF A01 - GPO	TI87900567	MN -78	12:22560
1243	NTIS, PC A04/MF A01 - GPO	TI87900535	MN -11	12:23533
NUREG/CP-				
0085	NTIS, PC A08/MF A01 - GPO	TI87900553	MN -70B	12:22301
NUREG/CR-				
3925-Rev.	NTIS PC E10/MF $6.75 - GPO	TI87006801	MN -70	12:22327
4301	NTIS, PC A25/MF A01 - GPO	TI87005451	MN -38	12:22598
4409-Vol.2	NTIS, PC A10/MF A01 - GPO	TI87005049	MN -41	12:23648
4541	NTIS, PC A09/MF A01 - GPO	TI87900560	MN -70	12:22302
4735-Vol.1	NTIS, PC A07/MF A01 - GPO	TI87900568	MN -70	12:22303
4744-Vol.1-No.1	NTIS, PC A03/MF A01 - GPO	TI87005737	MN -78	12:22447
4776	NTIS, PC A04/MF A01; 1	TI87006653	MN -38	12:23200
4793	NTIS, PC A04/MF A01 - GPO	TI87006118	MN -78	12:22599
4797	NTIS, PC A04/MF A01 - GPO	TI87900554	MN -78	12:22600
4818	NTIS, PC A03/MF A01 - GPO	TI87900552	MN -25	12:22858
4825	NTIS MF A01- GPO	TI87006888	MN -70	12:22304
4856	NTIS, PC A04/MF A01 - GPO	TI87005812	MN -41	12:23649
4861	NTIS, PC A07/MF A01 - GPO	TI87007073	MN -11	12:22601
NUREG/IA-				
0004	NTIS, PC A15/MF A01 - GPO	TI87900527	MN -78	12:22602
NVO-				
209-Rev.7	NTIS, PC A05; 3	DE87006773	STD -2	12:23399
NYSERDA-				
87-2	New York State Energy, Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223	TI87900565	MN -98B	12:22196
87-3	New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223	TI87900566	MN -90j	12:22158
NZERDC-				
132	*See* PB-87-132171/XAB			12:22191
OA-Trans-				
3269	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900021	MN -38	12:23211
OEFZS-				
4370	NTIS (US Sales Only), PC A02/MF A01	DE87701590	MN -48	12:23650
4377	NTIS (US Sales Only), PC A02/MF A01	DE87701591	MN -48	12:23651
4378	NTIS (US Sales Only), PC A03/MF A01	DE87701592	MN -34B	12:23417
4380	NTIS (US Sales Only), PC A02/MF A01	DE87701593	MN -48	12:23652
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0899	Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria		ND -34D	12:24180
0901	Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria		ND -4	12:23075
0902	Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria		ND -70	12:22305
0910	Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria		ND -4	12:23076
ORNL-				
6308	NTIS, PC A13/MFA01; 1 (GPO Dep.)	E 1.99: DE87006029	STD -37	12:23285
ORNL/M-				
301	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006447	MN -25	12:22928

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308	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87007698	MN -61A	12:22369
ORNL/RSIC-				
13-Vols.1-3-Rev.	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87006393	MN -32	12:24344
ORNL/Sub-				
84-89603/ 01	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87007697	MN -90h	12:22859
ORNL/TM-				
10074	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006019	MN -96	12:22775
10116	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87007795	MN -70A	12:22330
10232	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87005277	MN -38	12:22673
10258	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007799	MN -95f	12:23109
ORO-				
5126-300	*See* DOE/ER/05126-300	E 1.99: DE87002265	MN -34C	12:23987
OTA-ITE-				
317	*See* PB-87-139622/XAB			12:22670
OUP-				
83-15	NTIS (US Sales Only), PC A04/MF A01	DE87750898	MN -93	12:23941
83-16	NTIS (US Sales Only), PC A02/MF A01	DE87750899	MN -34C	12:23966
83-17	NTIS (US Sales Only), PC A05/MF A01	DE87750897	MN -34C	12:24041
83-24	NTIS (US Sales Only), PC A02/MF A01	DE87750911	MN -34C	12:23979
83-44	NTIS (US Sales Only), PC A02/MF A01	DE87750900	MN -34C	12:23967
86-17	NTIS (US Sales Only), PC A03/MF A01	DE87750683	MN -34B	12:23785
86-19	NTIS (US Sales Only), PC A02/MF A01	DE87750684	MN -34C	12:24042
86-20	NTIS (US Sales Only), PC A07/MF A01	DE87750682	MN -34D	12:23888
86-23	NTIS (US Sales Only), PC A03/MF A01	DE87750894	MN -34D	12:23889
86-26	NTIS (US Sales Only), PC A03/MF A01	DE87750693	MN -37	12:23367
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4,643,868				12:22494
4,643,870				12:22495
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A 6-838,494		E 1.99: DE87007218	MN -48	12:23590
A 6-853,104		E 1.99: DE87007232	MN -94c	12:22649
A 6-853,119		E 1.99: DE87007235	MN -48	12:23589
A 6-854,631		E 1.99: DE87007236	MN -48	12:23392
A 6-855,548		E 1.99: DE87007238	MN -93A	12:22701
A 6-868,388		E 1.99: DE87007183	MN -94cb	12:22648
A 6-883,216		E 1.99: DE87007194	MN -94cb	12:22647
A 6-886,491		E 1.99: DE87007198	MN -70	12:22316
A 6-889,131		E 1.99: DE87007201	MN -90b	12:22087
A 6-890,256		E 1.99: DE87007202	MN -94cb	12:22646
A 6-893,056		E 1.99: DE87007204	MN -25	12:23246
A 6-900,859		E 1.99: DE87007213	MN -25	12:22931
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87-126025/ XAB	NTISCP T99			12:23432
87-126033/ XAB	NTISCP T99			12:23475
87-129839/ XAB	NTIS, PC A15/MF A01			12:22666
87-130167/ XAB	NTIS PC PC E04/MF E01			12:22698
87-130449/ XAB	NTIS PC PC E05/MF E01			12:22213
87-130456/ XAB	NTIS PC PC E05/MF E01			12:23201
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87-130605/ XAB	NTIS PC PC E06/MF E01			12:22802
87-130613/ XAB	NTIS PC PC E06/MF E01			12:22803
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87-132783/ XAB	NTIS, PC A05/MF A01			12:23520
87-133583/ XAB	NTIS, PC A14/MF A01			12:22776
87-133732/ XAB	NTIS PC PC E12/MF E01			12:22777
87-133765/ XAB	NTIS, PC A06/MF A01			12:22778
87-134094/ XAB	NTIS PC PC E08/MF E01			12:22386
87-134102/ XAB	NTIS PC PC E03/MF E01			12:22166
87-134532/ XAB	NTIS PC PC E04/MF E04			12:23243
87-134581/ XAB	NTIS PC PC E04/MF E04			12:24345
87-135331/ XAB	NTIS, PC A04/MF A01			12:22779
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87-136768/ XAB	NTIS, PC A02/MF A01			12:22669
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87-136941/ XAB	NTIS, PC A08/MF A01			12:23434
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87-136966/ XAB	NTIS, PC A05/MF A01			12:22197
87-137121/ XAB	NTIS, PC A06/MF A01			12:22781
87-137196/ XAB	NTIS, PC A04/MF A01			12:24346
87-137204/ XAB	NTIS, PC A06/MF A01			12:22705
87-137477/ XAB	NTIS, PC A05/MF A01			12:22782
87-137485/ XAB	NTIS, PC A06/MF A01			12:22783
87-137584/ XAB	NTIS PC PC E04/MF E01			12:22816
87-137642/ XAB	NTIS, PC A07/MF A01			12:22791
87-137683/ XAB	NTIS, PC A10/MF A01			12:23534
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87-137972/ XAB	NTIS, PC A14/MF A01			12:23521
87-138095/ XAB	NTIS, PC A04/MF A01			12:23766
87-138327/ XAB	NTIS, PC A05/MF A01			12:22173
87-138335/ XAB	NTIS, PC A05/MF A01			12:22174
87-138772/ XAB	NTIS, PC A08/MF A01			12:22306
87-139036/ XAB	NTIS PC PC E03/MF E01			12:22784
87-139168/ XAB	NTIS, PC A05/MF A01			12:22809
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87-139416/ XAB	NTIS, PC A03/MF A01			12:22210
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87-139457/ XAB	NTIS, PC A03/MF A01			12:22163
87-139465/ XAB	NTIS, PC A05/MF A01			12:22164
87-139473/ XAB	NTIS, PC A02/MF A01			12:23140
87-139523/ XAB	NTIS PC PC E06/MF E01			12:22785
87-139556/ XAB	NTIS, PC A02/MF A01			12:23436
87-139572/ XAB	NTIS, PC A02/MF A01			12:22160
87-139598/ XAB	NTIS, PC A02/MF A01			12:22178
87-139606/ XAB	NTIS, PC A02/MF A01			12:22165
87-139622/ XAB	NTIS, PC A12/MF A01			12:22670
87-139952/ XAB	NTIS, PC A03/MF A01			12:22435
87-140125/ XAB	NTISCP T02			12:22180
87-140133/ XAB	NTIS, PC A07/MF A01			12:23437
87-140323/ XAB	NTIS, PC A09/MF A01			12:23249
87-140497/ XAB	NTIS, PC A03/MF A01			12:23110
87-140919/ XAB	NTIS, PC A06/MF A01			12:23438
87-140950/ XAB	NTIS, PC A10/MF A01			12:23439
87-140968/ XAB	NTIS, PC A09/MF A01			12:22436
87-141081/ XAB	NTIS, PC A10/MF A01			12:23522
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87-144358/ XAB	NTIS, PC A08/MF A01			12:22437
87-145637/ XAB	NTIS, PC A06/MF A01			12:23250
87-145645/ XAB	NTIS, PC A08/MF A01			12:23251
87-145702/ XAB	NTIS, PC A05/MF A01			12:23442
87-147591/ XAB	NTIS, PC A13/MF A01			12:22786
87-148763/ XAB	NTIS, PC A04/MF A01			12:22150
87-148797/ XAB	NTIS, PC A17/MF A01			12:22212
87-152500/ XAB	NTIS, PC A10/MF A01			12:23252
87-153938/ XAB	NTIS, PC A08/MF A01			12:22370
PCCF-T-				
85-04	NTIS (US Sales Only), PC A08/MF A01	DE87751146	MN -34D	12:23840
PH-				
432/ 86	*See* OEFZS-A-0899		ND -34D	12:24180
PNL-				
4800-Suppl.1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE87007356	MN -70	12:22307
5960	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87006879	MN -41	12:23666
6069	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87007156	MN -95f	12:22956
6137	*See* NUREG/CR-4856	TI87005812	MN -41	12:23649
PNL-SA-				
13763	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006438	MN -98	12:22660
14263	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006434	MN -11	12:23531
14369	NTIS, PC A02/MF A01; 1	DE87005607	MN -61D	12:22356
14409	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006437	MN -70	12:22308
14439	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006440	MN -11	12:23507
14580	NTIS, PC A02; 3	DE87006433	MN -71	12:23202
14591	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87004922	MN -48	12:23667
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14323	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006439	MN -70	12:22860
PPA-CR-				
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5	NTIS (US Sales Only), PC A02/MF A01	DE87701452	MN -11	12:23508
PPA-PR-				
1	NTIS (US Sales Only), PC A03/MF A01	DE87701453	MN -11	12:23509
8	NTIS (US Sales Only), PC A02/MF A01	DE87701594	MN -11	12:23510
9.1	NTIS (US Sales Only), PC A02/MF A01	DE87701595	MN -11	12:23511
9.2	NTIS (US Sales Only), PC A03/MF A01	DE87701596	MN -11	12:23512
10	NTIS (US Sales Only), PC A02/MF A01	DE87701597	MN -11	12:23513
11	NTIS (US Sales Only), PC A02/MF A01	DE87701454	MN -11	12:23514
15	NTIS (US Sales Only), PC A02/MF A01	DE87701451	MN -25	12:22861

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PPA-T-					
21	Nuclar Energy Unit, Kompleks PUSPATI, 43000 Kajang (MY)			ND -11	12:23515
45	NTIS (US Sales Only), PC A02/MF A01		DE87701627	MN -2	12:22482
47	NTIS (US Sales Only), PC A02/MF A01		DE87701598	MN -4	12:23159
55	NTIS (US Sales Only), PC A02/MF A01		DE87701599	MN -25	12:22862
56	NTIS (US Sales Only), PC A02/MF A01		DE87701600	MN -25	12:22863
PRI-					
105-Rev.	*See* SAIC-86/1904-Rev.	E 1.99:	DE87006576	STD -20g	12:24254
109	*See* SAIC-87/1559	E 1.99:	DE87006577	STD -20g	12:24255
PSR-					
1597	*See* AD-A-175840/8/XAB				12:23626
PTB-FMRB-					
108	NTIS (US Sales Only), PC A02/MF A01		DE87751226	MN -37	12:23368
PTB-ND-					
28	NTIS (US Sales Only), PC A06/MF A01		DE87751222	MN -37	12:23369
PTB-SE-					
10	NTIS (US Sales Only), PC A04/MF A01		DE87751207	MN -70	12:22309
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86-3	*See* PB-87-139036/XAB				12:22784
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TH Thailand
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TO Tonga
TR Turkey
TT Trinidad and Tobago
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TZ United Republic of Tanzania

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UG Uganda
US United States of America (USA)
UY Uruguay

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VE Venezuela
VI Virgin Islands of the United States
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